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LIFE IN OTHER WORLDS.

By Richard A. Proctor.

(*Continued from p.* 259.)

IN considering the case of Mars, I suggested the possibility that, owing to the relative shortness of that planet's life-sustaining era, the development of the higher forms of life may have been less complete than on our earth thus far (still less than the development of those forms on the earth in coming ages). We may well believe that during the long period of Jupiter's existence as a life-supporting planet, creatures far higher in the scale of being than any that have inhabited, or may hereafter inhabit, the earth, will be brought into existence. As the rule of nature on earth has been to advance from simple to more complex forms, from lower types to higher, so (following the argument from analogy) we must suppose the law of nature to be elsewhere. And time being a necessary element in any process of natural development, it follows that where nature is allowed a longer time to operate, higher forms, nobler types, will be developed. If this be so, then in Jupiter, the prince of planets, higher forms of animated conscious being will doubtless be developed than in any other planet. We need not, indeed, point out that the supposition on which this conclusion rests is merely speculative, and that now, when the laws of natural development have so recently begun to be recognised and are still so imperfectly known, the argument from analogy is (in this particular case) necessarily weak. Nevertheless, analogy points in the direction we have indicated, and it is well to look outwards and onwards in that direction, even though the objects within the field of view are too remote for us to perceive their real forms.

But, limiting our conclusions to those which may be justly inferred from known facts, let us inquire how the subject of life in other worlds presents itself when dealt with according to the relations above considered.

It is manifest at once that whether our new ideas respecting the present condition of Mars or Jupiter be correct or not, the general argument deducible from the analogy of our own earth remains unaffected. If Mars and Jupiter be at this moment inhabited by living creatures, it can only be because these orbs happen to be passing through the life-supporting period of their existence. We have shown that there is strong reason for believing this not to be the case; but if it is the case, this can only be regarded as a strange chance. For we have learned from the study of our earth, that the life-supporting era of a planet is short compared with the duration of the planet's existence. It follows that any time selected at random in the history of a planet is far more likely to belong to one or other of the two lifeless eras, one preceding, the other following the life-supporting era, than to belong to this short era itself. And this present time *is* time selected at random with reference to any other orb in the universe than our own earth. We are so apt to measure all the operations of nature by our own conceptions of them, as well in space as in time, that as the solar system presents itself (even now) as the centre of the universe, so this present time, the era of our own life, or of our nation's life, or of the life of man, or of the existence of organic beings on the earth, or (passing yet a grade higher) the era of our earth's existence as a planet, presents itself to us as the central era of *all* time. But what has been shown to be false with respect to space is equally false with respect to time. Men of old thought that the petty region in which they lived was the centre of the universe. After this was shown to be false by Copernicus, Kepler, and Newton, men clung in turn to the conception that the solar system is central within the universe. The elder Herschel showed that this conception also is false. Even he, however, assigned to the sun a position whence the galaxy might be measured. But it begins to be recognised that this is not so. Nay, not only is the sun no suitable centre whence to measure the stellar system, but the stellar system is for us immeasurable. The galaxy has no centre and no limits; or rather we may say of it what Blaise Pascal said of the universe of space—its centre is everywhere and its circumference nowhere. The whole progress of modern science tends to show that we must similarly extend our estimate of time. In former ages each generation was apt to regard its own era as critical in the earth's history; that is, according to their ideas, in the history of the universe itself. Gradually men perceived that no generation of men, no nation, no group of nations, occupies a critical or central position in the history of even the human race upon earth, far less in the history of organic life. We may now pass a step higher, and, contemplating the infinity of time, admit that the whole duration of this earth's existence is but as a single pulsation in the mighty life of the universe. Nay, the duration of the solar system is scarcely more. Countless other such systems have passed through all their stages, and have died out, untold ages before the sun and his family began to be formed out of their mighty nebula; countless others will come into being after the life has departed from our system. Nor need we stop at solar systems, since within the infinite universe, without beginning and without end, not suns only but systems of suns, galaxies of such systems, to higher and higher orders endlessly, have long since passed through all the stages of their existence as systems, or have all those stages yet to pass through. In the presence of time-intervals thus seen to be at once infinitely great and infinitely little—infinitely great compared with the duration of our earth, infinitely little by comparison with the eternities amidst which they are lost—what reason can we have when viewing any orb in space from our little earth, for saying *now* is the time when that orb is, like our earth, the abode of life? Why should life on that orb synchronise with life on the earth? Are not, on the contrary, the chances infinitely great

against such a coincidence? If, as Helmholtz has well said, the duration of life on our earth is but the minutest "ripple in the infinite ocean of time," and the duration of life on any other planet of like minuteness, what reason can we have for supposing that those remote, minute, and no way associated waves of life must needs be abreast of each other on the infinite ocean whose surface they scarcely ripple?

But let us consider the consequences to which we are thus led. Apart from theoretical considerations or observed facts, it is antecedently improbable that any planet selected at random, whether planet of our own system, or planet attending on another sun than ours, is at this present time the abode of life. The degree of improbability corresponds to the proportion between the duration of life on a planet, and the duration of the planet's independent existence. We may compare this proportion to that existing between the average lifetime of a man and the duration of the human race.

If one person were to select at random the period of a man's life, whether in historic, prehistoric, or future time, and another were to select an epoch equally at random, save only that it fell *somewhere* within the period of the duration of the human race, we know how exceedingly minute would be the probability that the epoch selected by the second person would fall within the period selected by the first. Correspondingly minute is the *à priori* probability that at this present epoch any planet selected at random is the abode of life. This is not a mere speculation, but an absolute certainty, if we admit as certain the fact, which few now question, that the period during which organic existence is possible on any planet is altogether minute compared with the duration of that planet's existence.

The same relation is probably true when we pass to higher systems. Regarding the suns we call "the stars" as members of a siderial system of unknown extent (one of innumerable systems of the same order), the chance that any sun selected at random is, like our own sun at the present time, attended by a planetary system in one member of which at least life exists, is exceedingly small, if, as is probable, the life-supporting era of a solar system's existence is very short compared with the independent existence of the system. If the disproportion is of the same order as in the case of a single planet, the probability is of the same order of minuteness. In other words, if we select any star at random, it is as unlikely that the system attending on that sun is at present in the life-bearing stage as a system, as it is that any planet selected at random is at present in the life-bearing stage as a planet. This conclusion, indeed, may be regarded as scarcely less certain than the former, seeing that we as little doubt the relative vastness of the periods of our sun's existence before and after his existence as a supporter of life, as we doubt the relative vastness of the periods before and after the life-supporting era of any given planet. There is, however, one element of doubt in the case of the star. The very fact of the star's existence as a steady source of light and heat implies that the star is in a stage resembling that through which our own sun is now passing. It may be, for instance, that the prior stages of solar life are indicated by some degree of nebulosity, and the later stages by irregular variations, or by such rapid dying out in brightness as has been observed in many stars. Yet a sun must be very nebulous indeed—that is, must be at a very early stage in its history—for astronomers to be able to detect its nebulosity; and, again, a sun must long have ceased to be a life-supporter before any signs of decadence measurable at our remote station, and with our insignificant available time-intervals for comparison, are manifested.

As to higher orders than systems of suns we cannot speculate, because we have no means of determining the nature of such orders. For instance, the arrangement and motions of the only system of suns we know of, the galaxy, are utterly unlike the arrangement and motions of the only system of planets we know of. Quite possibly systems of sun-systems are unlike either galaxies or solar systems in arrangement and motions. But if, by some wonderful extension of our perceptive powers, we could recognise the countless millions of systems of galaxies doubtless existing in infinite space, without, however, being able to ascertain whether the stage through which any one of those systems was passing corresponded to the stage through which our galaxy is at present passing, the probability of life existing anywhere within the limits of a galaxy so selected at random would be of the same order as the probability that life exists either in a planet taken at random, or in a solar system taken at random. For though the number of the suns is enormously increased, and still more the number of subordinate orbs like planets (*in posse* or *in esse*), the magnitude of the time-intervals concerned is correspondingly increased. One chance out of a thousand is as good as a thousand chances out of a million, or as a million out of a thousand millions. Whether we turn our thoughts to planet, sun, or galaxy, the law of Nature (recognised as universal within the domain as yet examined), that the duration of life in the individual is indefinitely short compared with the duration of the type to which the individual belongs, assures us, or at least renders it highly probable, that in any member of any of these orders taken at random, *it is more probable that life is wanting than that life exists at this present time.* Nevertheless, it is at least as probable that *every member of every order—planet, sun, galaxy, and so onward to higher and higher orders endlessly—has been, is now, or will hereafter be, life-supporting "after its kind."*

In what degree life-supporting worlds, or suns, or systems are at this or any other epoch surpassed in number by those which as yet fulfil no such functions or have long since ceased to fulfil them, it would only be possible to pronounce if we could determine the average degree in which the life-sustaining era of given orbs or systems is surpassed in length by the preceding and following stages. The life-sustaining orbs or systems may be surpassed many thousandfold or many millionfold in number by those as yet lifeless or long since dead, or the disproportion may be much less or much greater. As yet we only know that it must be very great indeed.

But at first sight the views here advanced may appear as repugnant to our ordinary ideas as Whewell's belief that perhaps our earth is the only inhabited orb in the universe. Millions of uninhabited worlds for each orb which sustains life! surely that implies incredible waste! If not waste of matter, since according to the theory every orb sustains life in its turn, yet still a fearful waste of time. To this it may be replied, first that we must take facts as we find them. And secondly, whether space or matter or time or energy appear to be wasted, we must consider that, after all, space and matter and time and energy are necessarily infinite, so that the portion utilised (according to our conceptions) being a finite portion of the infinite is itself also infinite. Speaking, however, of the subject we are upon, if one only of each million of the orbs in the universe is inhabited, the number of inhabited orbs is nevertheless infinite. Moreover, it must be remembered that our knowledge is far too imperfect for us to be able to assert confidently that space, time, matter, and force, though not

utilised according to our conceptions, are therefore necessarily wasted. To the ignorant savage, grain which is planted in a field instead of being used for food, seems wasted, the wide field seems wasted, the time wasted during which the grain is growing and ripening into harvest; but wiser men know that what looks like waste is in reality economy. In like manner the sun's rays poured on all sides into space so that his circling family receives but the 230 millionth portion, seem, to our imperfect conceptions, almost wholly wasted; but, if our knowledge were increased, we should perhaps form a far different opinion. So it may well be with the questions which perplex us when we contemplate the short duration of the life-sustaining condition of each world and sun and galaxy compared with the whole existence of these several orders. The arrangement which seems so wasteful of space and time and matter and force, may in reality involve the most perfect possible use and employment of every portion of space, every instant of time, every particle of matter, every form of force.

THE KALEVALA.

By Edward Clodd.

V.

THE story is interrupted in the eleventh rune by the appearance of the young, good-looking, hot-blooded Lemminkäinen, the gay Lothario of the piece. He is the son of Lempi, and is also known as Ahti, a sea-god, and as Kaukomieli, a surname given him on account of his adventurous life.

Leaving his wife that he might woo the maidens of the island of Saari, he made sad havoc with their hearts and reputations, only one of them, Kylliki, resisting his advances. This had the usual result of quickening his desire to win her, and, foiled in this, he carried her off by force. She yielded to the inevitable, and bargained with him not to go to the village dances if he would not go to the wars. But she broke her word, and thereupon Lemminkäinen left her and started for Pohjola to capture a bride from that country. When his mother sought to dissuade him from this, he threw down the hair-brush* which he was using, and angrily said that blood would flow from it if harm came to him. In this incident we have the survival of barbaric belief in sympathetic connection between a man and his image, or something belonging to him, the ill befalling the one being indicated by the other. It is also, as Mr. Lang remarks, a form of divination, as when the natives of Australia tie round a stick some of the hair of a person whose fate is to be ascertained.

On reaching Pohjola Lemminkäinen sent all the people to sleep by enchantment, except one wretched-looking herdsman, who seemed beneath notice, and who stole off to lay in ambush near Tuoni, the river of death. Lemminkäinen asked Louhi for the hand of her daughter, and was promised it on condition that he caught an elk belonging to Hiisi, the arch forest-demon, that he bridled Hiisi's fire-breathing horse, and shot the swan on the river of Tuoni. Like Wäinämöinen, he was successful in the first two feats, being aided by Ukko, but in the third he was surprised by the concealed herdsman, who killed him and cast his body into the river, where it was cut to pieces. Thereupon blood flowed from his brush, and his mother knowing thereby that evil had befallen him, hurried to Pohjola to learn his fate. "Then like Demêtêr seeking Persephonê, the mother questions all the beings of the world, and their answers show a wonderful poetic sympathy with the silent life of nature. 'The Moon said, I have sorrows enough of my own without thinking of thy child. My lot is hard, my days are evil. I am born to wander companionless in the night, to shine in the season of feast, to watch through the endless winter, to fade when summer comes as king.'"* Louhi deceived her, and at last the Sun told her where the fragments of the body were lying. Then, with a metal rake having teeth one hundred ells in length, she gathered up the scattered members and put them together; the birds brought magic balm from heaven, or, as in another version, a bee brought vivifying honey from "the cellar of Jumala," the goddess of man's blood gave her aid, and Lemminkäinen was restored to life.

In Esthonian myth, it is Kaleva who is killed by his brother Untamo or Hiisi, and cast into Tuoni's river. So in Egyptian myth Osiris is killed by his jealous brother Typhon, and thrown into the Nile. Isis, with grief bordering on madness, seeks her husband, as Kave Luonotar seeks Kaleva, as Lempi seeks Lemminkäinen. And as with his remains, so with those of Osiris, which Isis gathers together, only that one limb is missing, which has been devoured by fishes, and so likewise with Kaleva's, of which the eyes have been eaten by the guinard. Both are healed with honey, wax, and spices. In Greek myth, Medea, pursued by her father Æetes, to baffle his pursuit, dismembers Absyrtos and casts his limbs into the sea, when, the danger past, she reunites them by her magic spell. In German folk-tale, when a younger sister finds the fragments of her two sisters' bodies in the wizard's chamber, she gathers the limbs together, and, putting them in order, life returns.†

In the sixteenth rune we return to Wäinämöinen, who reappears as building the boat which Pohjola's maiden required, but as unable to finish it because he had forgotten the three magic words needful to that end. For these he sought in vain in Wainola. He was bidden to look for them in the topknot of a swallow, the wings of a wild goose, the tongue of a reindeer, and the lips of a white squirrel, but, although he shot hundreds of these creatures, he failed to find the lost words. So, as a last resource, he went to Manala or Tuonela, the under-world, in search of them. Tuonela, in the conception of the ancient Finns, was like the upper-world. The sun shone on it, the forests gave shelter to bears and wolves, the waters to fishes, but the forests were wrapped in gloom, the waters were black, and the cornfields brought forth teeth for the Tuoni-serpent. Tuoni, its ruler, was a pitiless old man, aided in his grim rule by his wife, a hag with hooked, iron-pointed fingers; by Tuonen-poika, his bloodthirsty son, and by his men-destroying daughters.

Arriving at the river's brink, he called to the maidens,

*Some of the variants say a comb. On the introduction of domestic and toilet articles in mythological stories, Mr. Ralston remarks in respect of a story in which the heroine effects her escape by means of a magic comb and towel, and in which trees spring up from the bristles of a brush, that, "metaphorically speaking, a brush may be taken as a miniature wood; the common use of the term brush-wood, is a proof of the general acceptance of the metaphor. A comb does not at first sight appear to resemble a mountain, but its indented outline may have struck the fancy of many primitive peoples as being a likeness to a serrated mountain range. Thence comes it that, in German, *kamm* means not only a comb, but also (like the Spanish *sierra*) a mountain ridge or crest."—*Russian Folk Tales*, p. 144.

* Lang. *Custom and Myth*, p. 171 and Le Duc's trans. Rune 15, p. 125.

† Grimm, *K. und H. M.*, III., 385 Eng. edition, No. 46, the "Fitcher's Bird." And cf. Ralston, *Russian Folk Tales*, p. 232.

who, like Charon, ferry the souls across, to bring their boat. But

> She, the virgin of Manala,
> She, the washer of the clothing,
> She, the wringer of the linen,
> By the river of Tuonela,
> In the under-world Manala,
> Spake in words and this their meaning,
> Forth the boat shall come from hither,
> When the reason thou hast given
> That hath brought thee to Manala,
> Neither slain by any sickness,
> Nor by death dragged from the living,
> Nor destroyed by other ending.

Then Wäinämöinen belied the epithet "truthful" bestowed upon him in Schiefner's translation. He told a series of lies to account for his coming, but at last spake the truth, and was ferried across. Tuonetar, the kindliest of the three maidens, brought him beer, but Wäinämöinen saw the frogs and worms in the jug, and would not drink it. Falling asleep, nets of iron and copper were spread over him, but he turned himself into a reed (or, as in some versions, a stone), then into an eel, and slipped through the meshes.

> Tuoni's son with hooked fingers
> Went to draw his net at morning—
> Salmon-trout he found a hundred,
> Thousands of the little fishes,
> But he found no Wäinämöinen.

After his narrow escape and fruitless journey, Wäinämöinen, when he returned to earth, warned men against Tuonela in language expressing ideas of reward and punishment foreign to the barbaric mind, and, therefore, probably referable to Christian influences:—

> In the course of your existence
> Deal not ill, O sons of mortals,
> With the men whose sons are sinless;
> Leave the innocent unharmed.
> Evil are the wages paid one
> In the household of Tuoni.
> There is set the couch of sinners;
> There the bed of evil doers;
> Under stones that burn for ever
> Under blocks of glowing granite,
> With a coverlet of serpents,
> Of Tuoni's swarthy reptiles.

We have almost a paraphrase of the scripture "Broad is the way," an echo of *facilis descensus Averni*, in this:—

> Many they who travel thither;
> Few who thence have found the home-way
> From the houses of Tuoni,
> From the dwellings of Manala.

Still in search after the needed Shibboleth, Wäinämöinen bethought him of the giant Antero Wipunen, who had been dead many a year, and who could be reached only by going along a road made of needle-tips of girls, sword-points of men, and battle-axes of heroes. Encased in iron armour made by Ilmarinen he passed over all these, and came to the grave of Wipunen, who slept so soundly that trees had sprouted from his body. These Wäinämöinen cut down, and then drove a crowbar into the giant's mouth, which awakened him. He swallowed Wäinämöinen, who caused him to break forth into song; and when at the end of it Wäinämöinen was cast out, he had heard the magic words in the verse which Wipunen had sung. Not only have we in this an illustration of that help and counsel sought from the dead which was practised among Greeks and Norsemen as well as among Finns, but also of the Shamanistic belief that the magician may in trance wander through the lower regions, and gain wisdom and strength from their inmates.

Having finished his boat, Wäinämöinen set sail in it for Pohjola; but Ilmarinen's sister found out his plans, and hastened to tell her brother, who hurried on horseback and overtook him. They agreed to abide by Louhetar's choice, which fell on Ilmarinen, as the younger and as the forger of the Sampo. But, as usual, conditions were imposed before he could marry her. He must plough with a golden plough in a field of serpents; he must muzzle the bear and the wolf of Tuoni; and he must catch without hook or net a pike that swims in the river of Tuoni. He succeeded in all, and when the "old and steadfast" heard it he turned his way homeward, warning the sons of men never to swim a match, or lay a wager, or go wooing with Ilmarinen the Smith, or with any man younger and lustier than one's self.

Several runes are now filled with the description of a Finnish wedding, which must be passed over in this analysis.

The preparations made in Pohjola for the marriage of Ilmarinen and Louhetar were on a colossal scale; the ox killed for the banquet had horns so far apart that a swallow would take all day to fly the space between them; and as to the brewing of the beer, a whole year was spent at it for lack of yeast, which, when obtained by a magic bird, worked so quickly that no vats could hold the liquid unless certain songs were sung by the drinkers, and the words of which Wäinämöinen, who "buried the hatchet" with his brother and came to the feasting, alone remembered.

Everybody in both Kalevala and Pohjola was asked to the wedding, except Lemminkäinen, for which slight he resolved to go to Pohjola despite the warnings of his mother and the threatened perils of the journey — the cataracts of flame, the islands of fire in a molten lake, which had to be passed, and the great serpent at the iron gates of Pohjola, which had to be overcome. This serpent, which guarded Louhi's house, reminding us of the sleepless dragon, longer than the ship Argo, which guarded the Golden Fleece, is thus described:

> Longer is it than a house-beam,
> Thicker than the entrance doorpost,
> Hundred eyes the serpent glares with,
> Thousand tongues the viper owneth:
> All the eyes are big as sift-sieves,
> All the tongues are long as spearshafts,
> Seven boat-lengths has the body.

After escaping these perils by the aid of charms, Lemminkäinen reached Pohjola, where the mistress gave him no welcome. A quarrel ensued, ending with a duel, in which Lemminkäinen cut off the head of the representative champion of Louhi, and then, fearing her vengeance, made hasty escape home, and asked his mother to hide him from the Northland pursuers. She told him how hard this was; hard for a fir or a birch-tree that may be cut down; hard for the bilberry that may be picked; hard, too, for the pike in the waters and the bear in the woods; but harder still for a hunted man. But at her counsel he went to the island of Saari, the scene of his old amours, where he played with renewed vigour the part of Don Juan until he was expelled by the husbands and brothers whom he had wronged, and by the one girl whom he had *not* wronged.

On reaching Kalevala, he found his house burned down and his mother missing; but, to his joy, he discovered her hiding-place, and, after promising to return and restore the homestead, he set out for Pohjola with Tiera, an old comrade-in-arms, to avenge himself of his adversaries. Louhi, thereupon, sent against him no armed men, but the Frost-Giant, whose father was the north-wind, whose foster-mother was the serpent, nurturing him on its barren breasts, whom the ice-wind lulled to slumber in the midst of the

XUM

swamp where the waters have their birth. Lemminkäinen overcame him by the power of words, but in the end had to beat a retreat.

IS THE DIAMETER OF THE PUPIL OF THE EYE AN EQUIVALENT OF THE LIGHT'S INTENSITY?

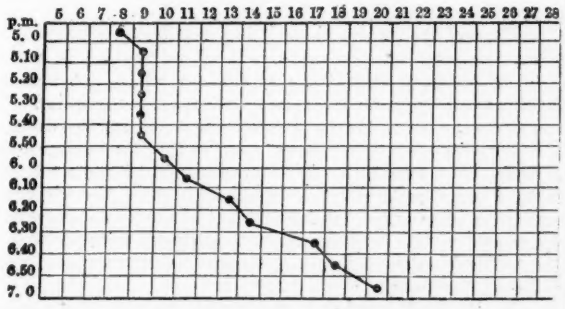
By John Gorham, M.R.C.S. Eng.

(From a paper read before the Royal Society in November, 1884.)

(*Continued from page* 285.)

We have next to furnish ourselves with specimens of light of different intensities, in order to ascertain whether there is any coincidence between them and the magnitudes of the pupil. We are not long in discovering that the light of the atmosphere, as reflected from the sky, is well adapted for the purpose; for, although very variable in brightness, the variations are characterised by distinct periodicities in accordance with meteorological changes in the atmosphere: hence the variations are definite, and may be anticipated from day to day. These changes occur almost hourly, but they are much more frequent and rapid when the evening twilight is succeeding upon the sunset. The subjoined diagram (Fig. 1) shows the effect of the evening twilight upon the pupil when examined every ten minutes consecutively for two hours from 5 p.m. to 7 p.m. The light chosen was that from a small area of the S.W. sky, about 11° above the horizon. What this experiment is specially intended to show is the remarkable coincidence in the rapid departure of the light during the second hour, and the similarly rapid dilatation of the pupil. Our ordinary sense of vision pronounces upon the fact of the light's decrease that it is getting sensibly duller every few minutes. Our pupil indicates the same fact, but more accurately, by defining the amount of dulness in fractions of an inch.

Sept. 19, 1884.—Fair, Sunny Day. Diameters of the Pupil, in Hundredths of an Inch.



Diameter of pupil every consecutive ten minutes from 5 p.m. till 7.

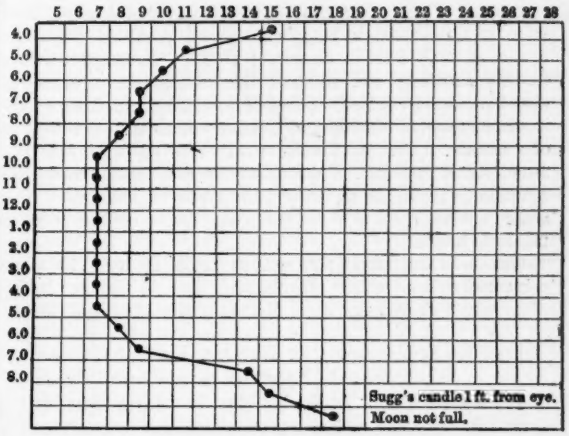
Fig. 1.

We may now try the effect of sky light on the magnitude of the pupil every consecutive hour throughout one day.

These experiments were commenced at four in the morning, and terminated at eight in the evening, after which a standard Sugg's candle was substituted for the twilight, and finally the light of the moon. The whole of these pupil measurements are seen to coincide in a remarkable manner with the changes in the light's brilliancy throughout the day, as well as with the feeble light of the candle, and the still feebler light of the moon.

The feeblest light registered in the diagram (Fig. 2) was moonlight, indicated by a pupil diameter of ·18 in.; next that of the morning twilight at 4 o'clock, and of the candle, the pupil measuring the same in both.

Aug. 2, 1884.—Fair, Sunny Day. Diameters of Pupil in Hundredths of an inch, from 4 A.M. till 8 P.M.



Diameters of the pupil from 4 o'clock in the morning to 8 in the evening.

Fig. 2.

In obtaining these results we have trusted to the resources of the pupil alone registering its indications, regardless of any foregone conclusions as to the quality of the light derived from our mere judgment or sense of sight. The question again presents itself to the pupil's indications and its varying intensities of daylight coincide. In no single instance has a discrepancy yet arisen: a dull light

Oct. 6, 1884.—Diameters of Pupil in Hundredths of an inch. Eclipse of Moon.

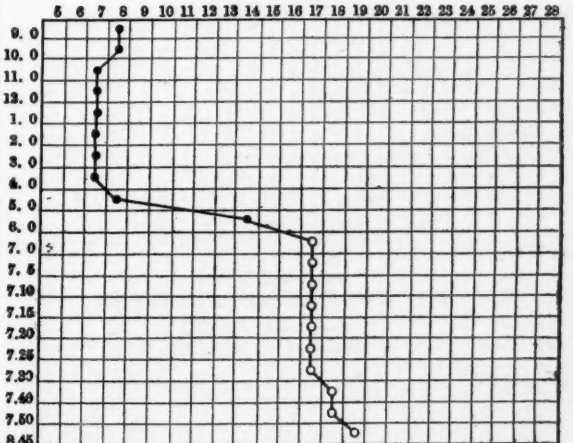


Fig. 3.

having been invariably accompanied by a dilated pupil, a bright light by a contracted one, while with a light of known absolute intensity, as that of a Sugg's candle, the

pupil has always remained of one definite size at a prescribed definite distance.

The Diameter of the Pupil when Stimulated by the Light of the Moon.

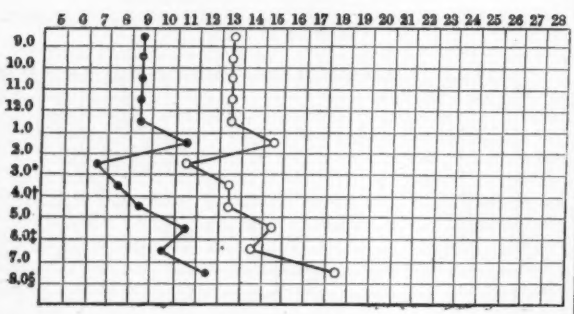
From numerous experiments on the full moon, my own pupil invariably measured the 17·00th of an inch in diameter. It becomes dilated to the same size when held at 4 ft. 6 in. from a Sugg's standard candle. Now, the square of 4 ft. 6 in. is equal to 20·25. Hence, according to this showing, the light of the full moon is equal to about the one-twentieth of that of the candle. In other words, it would require the light of twenty moons to make that of one candle. Dr. Wollaston made the light of the full moon much weaker. According to his experiments, full moonlight is equal to only the $\frac{1}{14}$th of a candle; but some previous French experiments made it nearly three times as much.

On the occasion of the eclipse (Fig. 3) at 7.40 p.m., the pupil dilated to the ·18 in., and at 8.45 to the ·19 in., after which it was too dark to obtain another observation.

Disparity in Size of the Normal Pupil in Different Persons.

It may be stated *in limine* that if from a light of the same intensity the measure proves different in two persons, that of both or of either may be equally correct. From numerous experiments it results that, so far from the pupil having the same size in all, it is scarcely alike in two consecutive cases, but that each person, it is more than probable, has a pupil range of his own. This is shown in the subjoined chart (Fig. 4), where the two measures of the light's intensity, or of the diameters which we assume to be so in two different persons, are different, yet both are equally reliable, for while the disparity continues throughout the day, the absolute numbers varying,

June 6, 1884.—Dull, Cloudy, no Sun, some Rain. Diameters of Pupil in Hundredths of an inch.



●—● = A.'s pupil.
Sum of Diameter, = 113; Mean, = 9·4

○—○ = B.'s pupil.
Sum of Diameter, = 163; Mean, = 13·5

* Sun suddenly. † Sun watery. ‡ Raining hard. § Fin

Fig. 4.

their differences remain the same within the hundredth of an inch or so, in all.

It has been found useful to *set* the pupil in individual cases to some ordinary standard, say a Sugg's candle, at at one foot from the eye. My own pupil, when thus tested, measured the ·15 inch. We can now dispense with the candle in making a comparison with other lights, using instead the diameter of our own pupil. In this way we become acquainted with the relative luminosity of certain lights stated numerically, of which previously we had not the remotest idea. The light of the full moon, for instance, invariably dilates my pupil to the ·17 inch, that of a standard candle to the ·15 inch, and that of a S.W. sky in sunshine to the ·07 By comparing these three lights, of the moon, the candle, and the sky, by using the numbers ·17, ·15, and ·07, our ideas as to their relative intensities become more definite.

(To be continued.)

RAIN.

By Richard A. Proctor.

(Continued from p. 255.)

THE influence of the seasons remains yet to be mentioned among the circumstances affecting the distribution of rain over the earth's surface. The influence of the seasons is different in different zones of the earth's surface. Under the tropics the laws affecting the fall of rain are much more regular than elsewhere. On the ocean we have clear skies when the trade-winds are blowing steadily, and heavy rain falls by day over the intermediate zone of calms; but on the land we have regular dry and wet seasons within the tropics. There is, properly speaking, no winter or summer; but applying these terms to the periods at which winter or summer prevails in the temperate zones of either hemisphere, we may say that the sky is serene in the winter, becomes moist in spring, and the rainy season sets in when the sun is near the zenith. Where there is a considerable interval between the sun's passages of the zenith, as in places not very far from the equator, there are two wet seasons, both occurring in summer. In countries in which monsoons prevail, however, the alternation of dry and wet seasons depends on the winds. When the south-west monsoon is blowing over India, for instance, there is no rain on the east coast, but abundant rain on the west coast. During the north-east monsoon these conditions are reversed. A little consideration will show that all the above-mentioned seasonal variations within the tropics depend on general laws already stated.

Beyond the tropics there is less regularity. The fall of rain depends on the prevalence of certain winds which bring moisture with them, and, these winds not blowing with any regularity, the rainfall is similarly irregular. In countries close to the tropics, there is a noteworthy dryness in summer; for this reason clearly, that in summer the trades blow over these regions, and bring with them "trade-wind weather." Further north, however, though there may be a tendency to the prevalence of north-easterly winds in summer, this tendency is not so marked as to produce a considerable defect of rain in the summer as compared with the winter months.*

In England we have one cause affecting the rainfall which is worthy of special notice. I refer to the Gulf Stream. The air above this warm stream is not only warmer than the surrounding air, but is heavily laden with moisture. When the western and south-western winds loaded with the vapour of water begin to blow over England, they precipitate their moisture in rain, as they encounter the colder air, over the land; but the manner in which this happens is variably with the seasons, for in the winter

* So far as my own observations extend, I should say that the two features of our climate which may be most certainly depended on—which, be it noted, is not saying much—are, heavy rains in July, generally in the last fortnight, and serene weather during the second week of November.

months the moisture-laden winds blow lower, and therefore precipitate their vapour earlier; whereas in summer the clouds range higher, and therefore travel farther inland before they fall in rain. The same effects are observable in the Scandinavian peninsula, Norway receiving more rain in winter than in summer; while Sweden, on the eastern side of the Dovrefelds, receives more rain in summer than in winter.

Such are some of the general laws which affect the downfall of rain in various countries and at different seasons. There is one circumstance involving the action of a yet grander law — about which, however, considerable uncertainty still exists. I refer to the difference observable between the northern and the southern hemispheres. It has been already noted that the mean position of the medial zone of calms and heavy diurnal rainfalls lies some 4° or 5° to the north of the equator. The total annual downfall of rain north of this medial line is slightly greater (so far as our present information extends) than the downfall south of the medial line. And, therefore, since the area of the northern region is less than the area of the southern, it is clear that the annual downfall over any northern zone is, in general, considerably heavier than the downfall over the corresponding southern zone. Now, if we remember that the amount of aqueous vapour raised by evaporation over the southern or watery hemisphere must necessarily be much greater than the amount raised over the northern hemisphere, this result will appear a remarkable one. One would expect to find a difference—and a very marked difference—between the two hemispheres; but instead of the excess of rainfall being in favour of the northern hemisphere, one would expect it to have been in favour of the southern.

If we assume with Maury that the north-easterly and south-easterly trade winds which meet near the equator merge, respectively, into the north-westerly and south-westerly counter-trades—that is, that they cross over to the opposite hemisphere to that in which they were generated—the difficulty seems to vanish. For, in this case, the downfall over the northern hemisphere is due to evaporation over the southern hemisphere, and *vice versâ*. Maury adduced other arguments in favour of his theory of an intercrossing of this sort. Sir John Herschel, however, declined to adopt "the doctrine recently propounded of a systematic crossing of the south-east and north-east trades at the medial line. In so doing," he was "in no way disturbed by the phenomenon of infusorial dust of South American origin which occasionally falls on the north-east of Africa," and so on. I must confess that the balance of evidence seems to me to lie on Maury's side in this instance.

It may be asked, however, whether there is any occasion to adopt either view as a systematic account of the laws affecting the trades and counter-trades. May not Maury and Herschel be like the two knights who saw opposite sides of the same shield, and who—both right and both wrong—were persuaded, one that the shield was silvern, the other that it was golden?

If we remember that the medial line marks a zone of calm towards which, from either hemisphere, immense masses of moisture-laden air are continually being swept in, why should we arbitrarily assign to the masses of air passing away above from this calm zone, such a law of motion that every particle of air which has originally come from the northern hemisphere shall take one course, and every particle which has come from the southern shall take an opposite one? It appears to me, on the contrary, that an intermingling (in masses, it may be, but still complete) must take place above, and result in an almost indifferent diffusion of the vapour-laden air northwards and southwards with the returning counter-trades. The fact that the northern trades have a southernly motion as they enter the calm zone (passing here upwards), and *vice versâ*, may lead to a slight preponderance of air (originally) from the northern hemisphere in the north-westerly counter-trade, and *vice versâ*, but by no means (I should think) to anything approaching the systematic intercrossing imagined by Maury. On the other hand, the preponderance might lie the other way, owing to the effects of collision between the northern and southern trades—but without leading to the systematic return of northern air to the northern temperate zone, and of southern air to the southern temperate zone, conceived to take place by Sir J. Herschel.

One of the most remarkable results of observations made upon rain, has been the discovery that the amount of fall at any place diminishes largely as the rain-gauge is raised above the level of the ground. It is not very easy to explain this remarkable fact. The explanation offered by Kämtz was, that a falling drop carries with it the temperature of the upper regions of air, and condenses on its surface the aqueous vapour present throughout the lower strata of the atmosphere, as a decanter of cold water does when brought into a room. Professor Nichol remarks that this explanation "is not an hypothesis but a rigorous deduction, giving an account of all the facts as yet ascertained in connection with this subject." But unfortunately, the explanation, though it undoubtedly presents a *vera causa*, will not bear the test of "quantitative analysis." Sir John Herschel has gone through the simple calculation required to overthrow the theory, and points out that, if we allow to the cause the full value it can possibly have (a value far exceeding that which can *probably* be attributed to it), we obtain an effect only one-seventeenth part of what is wanted to account for the phenomenon. Sir John points out also that obliquity of fall cannot possibly affect the observed amount of rainfall, and he offers no hypothesis in explanation of the phenomenon, and remarks, in conclusion, that "visible cloud rests on the soil at low altitudes above the sea-level but rarely; and from such clouds alone would it seem possible that so large an accession of rain could arise." He refers, however, in a note to a paper read by Mr. Baxendell to the Literary and Philosophical Society of Manchester on this subject, in which it is inferred that the only way of accounting for the phenomenon lies in the admission of the existence of water "not in the state of true vapour," but already deprived of its latent caloric, though not affecting the transparency of the air, so that "a shallow stratum of the lower and comparatively clear atmosphere" may "supply as much rain as a densely-clouded and much deeper stratum in the higher regions." Mr. Baxendell mentions also the interesting fact, that the drops of water which drip from the upper part of the shaft increase to an extraordinary size in the descent to the bottom.

It appears to me that the well-known phenomenon of rain falling from a clear sky—a rain termed by the French *serein*—has a suggestive bearing on the peculiarity we have been considering. It proves that water may exist, even in drops, in the atmosphere, without appreciably affecting its transparency. And though it may be an uncommon thing for rain to fall without appearing first in the upper regions of air—in the form of cloud, yet it by no means follows that *during a shower* rain might not be falling from the lower as well as from the upper air-strata, without the transparency of the lower strata being much or at all affected. I have noticed, always, that if the eye be directed steadily at the drops of heavily-falling rain, there will be seen flitting, as it were, among them minute specks, which are seen on a closer observation to be small particles of

XUM

water. Now, it does not appear to me likely that these, or most of them, are produced by the collision of the falling drops—for the paths of two neighbouring drops must be parallel, since the drops are subjected to precisely the same set of influences.

I believe the phenomenon to be one worthy of more careful notice than it has received—in fact, I am not aware that it has been noticed at all. The motions of the particles are themselves interesting—seeming almost as independent of gravitation, wind-currents, or the like, as the motion of a flight of insects would be. It is hardly necessary to observe that if these particles show that rain is being generated in the lower as well as the upper strata of the air, all difficulty in explaining the results of Professor Phillip's observations vanishes at once.

THE YOUNG ELECTRICIAN.

By W. Slingo.

(*Continued from p.* 232.)

SCREWS.

In every branch of mechanical industry, screws of various shapes and sizes take a most prominent part, and a knowledge of their functions and properties is essential to one who aspires to any degree of efficiency in electrical instrument making. Let us, then, turn our attention to what may be regarded as the mainstay of almost every piece of apparatus—good screws.

Ex. XLII.—The primary function of a screw is to afford a ready means of attaching two pieces of metal, wood, &c. Were this the only object, however, simpler and cheaper methods could be resorted to, such as riveting (in the case of metals), or nailing (in the case of wood). A screw is superior to either of these latter processes in more ways than one. Briefly, these superiorities may be thus enumerated.

(*a*) The parts fastened together by means of a screw are, or should be, always detachable.

(*b*) The parts so fastened are held together more firmly than is, generally speaking, possible when either of the other modes of attachment is adopted. Of course, nothing in the way of attachment can excel the rivet when the hole is made perfectly round, the rivet perfectly fitted and driven in *hot*, the head being also made while the metal is in that condition; then an almost solid mass results. But with such work as this we shall have practically nothing to do, and we may confine ourselves, therefore, to the question of screws.

(*c*) Screws, when driven home, have the, to some extent, exceptional power or property of drawing the parts firmly together.

The features essential to the character of a good screw are:—

(*a*) Sufficient strength must be possessed by the screw to enable it to draw the parts together without stripping the thread, and to withstand such strains as may be exerted upon either of the parts.

(*b*) The thread must be sufficiently substantial to allow of the screw being driven and withdrawn a number of times without impairing it.

Ex. XLIII.—Screws may be divided into two classes:—

(*a*) Those intended for wood-work, and

(*b*) Those intended for metal-work.

Fig. 17*a* illustrates the universally-known wood screw, in which the head is finished for a counter-sunk hole.

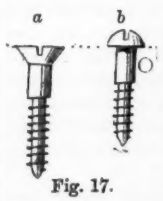


Fig. 17.

Another form of wood screw is depicted in Fig. 17*b*, in which the underside of the head is flat. The thread is thin, and the distance between the threads (called the "pitch") comparatively great, in order that the thread formed in the wood shall be approximately equal in strength to the thin thread on the screw.

There are many varieties of metal screws. They are named according to the number of threads cut in each inch of metal. So far as the threads are concerned, they generally take one or other of two forms, viz., the square and the V-shaped. With the former, however, we shall have little or nothing to do. Let us, therefore, direct our attention to the other class, which we shall have frequent occasion to use. The best class of V-shaped thread for heavy work is doubtless that known as the Whitworth, with which we will deal presently.

The young electrician will, as a rule, require only small screws, not made after the Whitworth pattern. The thread is comparatively fine, and each maker has his own particular pattern. There are naturally several sizes suitable to the various requirements. One feature pertaining to metal

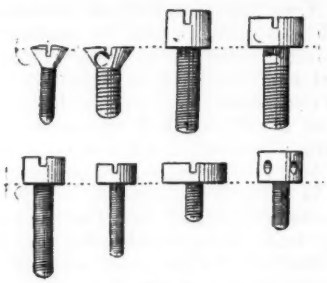


Fig. 18.

screws is the variation in the head. Fig. 18 illustrates a number of screws in which heads of different sizes and shapes are employed. It will be noticed that some are long and narrow, specially applicable when the head has to be let into a hole, while others are wide and short. The latter are useful when it is desired to cover up a small hole. The screws illustrated are of various sizes, but to similar sized heads screws of many different dimensions are procurable.

THE SCREW-PLATE.

Ex. XLIV.—The next tool claiming our attention is the screw-plate, Fig. 19, which consists of a thin sheet of hardened steel containing a number of screw-holes provided with cutting edges formed by smaller holes drilled at the extremities of a diameter of the screw-hole so as to cut away portions of the thread. The function of the screw-plate is to enable one to make screws ranging in size up to about an eighth of an inch in diameter, and to make other tools known as "taps," the use for which is to prepare a thread in the piece of metal which is intended to receive the screw. Obviously, then, the screw-holes in the plate are of various sizes, although the thread is in each case identical. The drilled holes which provide the cutting edges also afford means of exit for the metal shavings cut from the piece of wire, &c., upon which the thread is being produced.

SCREW-MAKING.

Ex. XLV.—There is, of course, a right and a wrong way of using a screw-plate. Let it be supposed that we wish by its means to make a screw. Having determined

the hole in the plate which it is intended to use, select a piece of round metal having the diameter of the head of the screw to be made; then reduce one end of this piece of metal to the length and outside diameter of the screw (see Ex. XXIX.), tapering the metal for about an eighth of an inch from the small end, in order that an entry into the hole in the screw-plate may be easily effected. Fix the metal in the hand-vice (Ex. XXVIII.); then, having effected this entrance, commence carefully to screw the metal into the screw-hole, turning it as long as it progresses with a moderate degree of freedom. Then turn it backwards slightly to relieve the strain exerted upon the thread under formation, and repeat the forward movement. Continue this process until the required amount of thread is produced. Oil should be used with all metals, brass excepted.

To form the head of the screw, cut off sufficient of the unthreaded portion of the metal to leave a head of the necessary length, using a frame or back saw (Ex. XIX. and XX.) for the purpose. Having smoothed the head with a file, cut by means of either of these saws the usual slot to carry the screw-driver.*

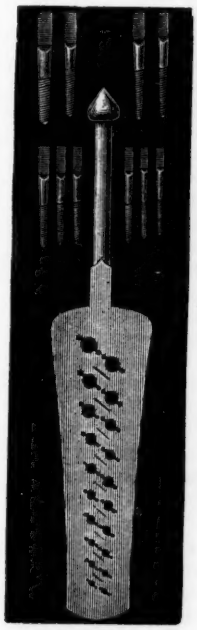


Fig. 19.

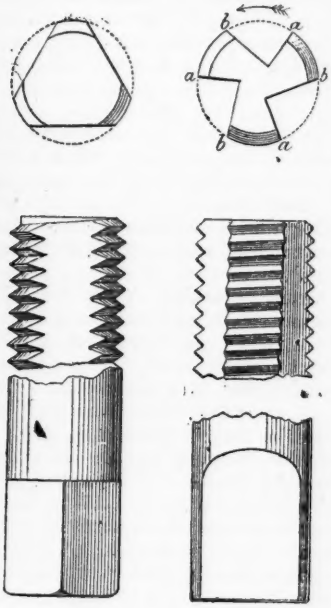


Fig. 20.

Fig. 21.

TAPS.

A tap, as above indicated, is a tool for producing a thread in the hole into which a screw is to be driven. It is, therefore, a cutting tool, and a most important one too. It is generally made by cutting a thread on a piece of wire, and then cutting away longitudinal sections until cutting edges of the required depth, &c., are provided. A set of taps is usually sold with a screw-plate, but the worker will speedily be impressed with the fact that they are not, as a rule, as effectual as they might be. He will often find it impossible to tap a shallow hole of uniform diameter. Indeed, most workmen prefer, and so it is believed will our young experimenter, to use home-made taps.

Ex. XLVI. — Fig. 20 represents, on a considerably enlarged scale, the type of tap frequently met with. By reference to the plan and cross section, it will be seen that the tap is made by simply cutting away three longitudinal sections until the cross-section approximates somewhat closely to an equilateral triangle. The great defect pertaining to this tool is that the cutting edges, instead of *cutting away* the metal, partially drive or push it away. One great effect of this is the exertion of a considerable strain upon the tap, with the result that it often gives way, breaking off in the hole.

Ex. XLVII.—Another frequently sold form is one in which four longitudinal sections are removed, giving a cross section something like a square. The same disadvantages inherent in the triangular tap are present in this form, and to an intensified degree. Moreover, the small amount of metal removed from the tap afford little or no egress for the cuttings produced by it.

Ex. XLVIII.—A much better form is that illustrated in Fig. 21, and is the one which the young electrician is recommended to make for himself. The usual thread is cut in a piece of wire by means of the screw-plate (Ex. XLV.). The best bright steel wire should be employed, the same as that recommended for drills (Ex. XXIX.). Such a size should be selected as will correspond with the diameter of the screw which is to be driven into the hole after it is tapped. Should the diameter of the wire be too great, reduce that portion of it which is to carry the thread to the required thickness. To produce the cutting edges, secure the unthreaded end in a vice. Then with a small three-square file cut three grooves, at equal distances apart, throughout the entire length of the thread, and somewhat deeper than the bottom of the thread. Leaving the enlarged plan to explain itself, a little attention bestowed upon the sectional view is necessary. It will there be seen that sides of the groove are not equal in depth, nor do they bear the same angular relation to the surface of the tap. The arrow indicates the direction in which the tap will revolve, whence it will be seen that *a a a* will be cutting edges, and that they will *actually cut* forward into the metal, while *b b b* take no part in the cutting. The groove between *a* and *b* afford a means of egress for the metal cuttings produced by *a*. The advantages, then, which this form of tap possesses over the previously-described forms are the acute cutting edges *a a a*, and the increased facility for the removal of cuttings. These features imply more rapid working and a considerable reduction of the risk of breaking the tap. It is almost superfluous to mention that this proneness for common taps to break inside the hole is exceedingly tiresome, resulting frequently in effectually spoiling the outcome of many hours, or even days, of industrious labour.

Before using this tap it will require hardening. Heat the cutting end of the tap to cherry-red by either of the processes described in Ex. XXX. Then dip it *vertically* in either oil or water. Do not remove it from the liquid until it is cold.

Preparatory to tempering, clean the grooves by means of a piece of fine emery-paper, bent once round a small three-square file, care being taken not to injure the cutting edges. Next, with a pair of pliers, hold the shank or unthreaded end in a flame until the other end assumes a deep straw colour. Then plunge the tap immediately into water or oil.

When cool, file two flat and parallel faces on the shank end, and the tap will be ready for use.

(To be continued.)

* The orthodox method of making screws is by means of a lathe. I am sorely tempted to dilate upon the uses and choice of such a tool, but I am restrained from so doing by the fact that this series of papers is intended for the young electrician who has no tools to start with, and who is only able to expend a few shillings at a time.

THOUGHT AND LANGUAGE.

By Ada S. Ballin.

VII.

GESTURES expressive of volition are, as I observed in my introductory article, common both to man and the lower animals.

Those who have observed the habits of animals will recall instances in which they have witnessed gestures voluntarily performed for the purpose of communicating a wish to another of the animal's own species or a distinct species. Some interesting evidence bearing on this subject has been collected and published by Mr. Romanes in his valuable work on "Animal Intelligence,"* from which I quote the following cases :—

Mr. Blackman tells him of a cat which, "whenever it wanted to go out, would come into the sitting-room and make a peculiar noise to attract attention; failing that mode being successful, it would pull one's dress with its claw, and then having succeeded in attracting the desired attention, it would walk to the street-door and stop there, making the same cry until let out." I believe such cases as this are not at all uncommon, but one still more remarkable is communicated by a correspondent of whose good faith Mr. Romanes is certain.

A cat and parrot were very good friends, and lived in harmony in a kitchen. "One evening there was no one in the kitchen. Cook had gone upstairs and had left a bowl full of dough to rise by the fire. Shortly after the cat rushed up after her, mewing and making what signs she could for her to go down; then she jumped up and seized her apron, and tried to drag her down. As she was in such a state of excitement, cook went and found Polly shrieking, calling out, flapping her wings, and struggling violently, 'up to her knees' in dough, and stuck quite fast. No doubt, if she had not been rescued she would have sunk into the morass and been smothered." A similar example, of which a dog was the hero, is related by Dr. Beattie. A gentleman named Irvine was crossing the Dee when it was frozen. About the middle of the river the ice gave way beneath him, but he kept himself from sinking by placing his gun across the hole. His dog "made many fruitless efforts to save his master, and then ran to a neighbouring village, where he saw a man, and with the most significant gestures pulled him by the coat, and prevailed on him to follow. The man arrived on the spot in time to save the gentleman's life." Books of anecdotes about animals are full of similar instances. Mr. A. Percy Smith writes to Mr. Romanes about a cat whom he punished when her kittens misbehaved. After a little time she began to train the youngsters, and "she swore at them and boxed their ears, until she taught the kittens to be clean," and D'Osbonville observed certain monkeys in the wild state administer corporal punishment to their offspring. They would watch the little ones at their play, wrestling and chasing each other; but if any grew spiteful the mothers would spring up, seize them by the tail with one hand, and correct them severely with the other.

A complicated series of gestures comprised in my first and second class is described by Mr. James Forbes, F.R.S., in his "Oriental Memoirs" as having been observed in monkeys :—"One of a shooting-party under a banian-tree killed a female monkey, and carried it to his tent, which was soon surrounded by forty or fifty of the tribe, who made a great noise and seemed disposed to attack their aggressor. They retreated when he presented his fowling-piece, the dreadful effect of which they had witnessed, and appeared perfectly to understand. The head of the group, however, stood his ground, chattering furiously; the sportsman who, perhaps, felt some little degree of compunction for having killed one of the family, did not like to fire at the creature, and nothing short of firing would suffice to drive him off. At length he came to the door of the tent, and finding threats of no avail, began a lamentable moaning, and, by the most expressive gesture, seemed to beg for the dead body. It was given him; he took it sorrowfully in his arms, and bore it away to his expecting companions."

In connection with my present subject, the example of "The Hospital Dog" will probably rise in the minds of my readers. This dog managed very clearly to explain what he wanted to the authorities of Charing-cross Hospital; and the following account of his behaviour was communicated by the secretary, Mr. Arthur Reade, to the *Daily Telegraph* of December 9th last :—"About half-past ten last night the porter heard a dog whine outside the hall-door of the hospital. He opened it, and a rough terrier limped in, squatted on the mat, and held up his right forepaw. The porter, seeing that the limb was injured, fetched the house-surgeon. . . . The house-surgeon dressed it, and the dog immediately testified his gratitude by licking his hand and barking loudly."

Many gestures performed by animals constitute, as it were, a bridge between gestures expressive of volition (my second-class) and those which convey cognitions (my third class).

Ants, according to Sir John Lubbock's experiments, appear able to communicate the fact that they have found treasure to great or small amount, but not to describe the exact locality of it; perhaps, however, a sign meaning "follow me" is repeated until a number sufficient for the work are collected together, and the discoverer then leads them in triumph to the goal. They communicate by means of their antennæ, and are certainly able to announce the fact of a disaster. It is possible, however, that their powers of communication are chiefly, if not wholly, limited to gestures expressive of emotion, or will, as the "follow me" sign. Hague, having killed a few ants, saw their companions running hither and thither about the scene of calamity, "stopping at times and elevating their antennæ with a movement suggestive of wringing them in despair."* They exhibit many signs of excitement and fright. It seems improbable that ants can communicate many ideas; but their life is social to an extent far surpassing that of any other animal but man; from which we may infer that their means of communication is superior to that of any other animal but man.

Other creatures, however, act in concert. Miss Bird† speaks of three crows who had vainly attempted to tear a piece of meat from a dog. "After a consultation they separated, two going as near as they dared to the meat, while the third gave the tail a bite sharp enough to make the dog turn round with a squeak, on which the other villains seized the meat, and the three fed triumphantly upon it on the top of a wall."

Edwards, the naturalist, once observed two turnstones endeavouring to turn over the corpse of a cod-fish. After labouring "at both sides alternately for half-an-hour, they were joined by another of their own species," which was

* This volume is an excellent text-book for the subject on which it is written, and in this and the next article I shall quote from it freely. The various cases, however, will be used for the most part in illustration of points quite different to those in relation to which Mr. Romanes employs them.

* "Nature," Vol. VII., p. 434.

† "Unbeaten Tracks in Japan," Vol. II., p. 150.

hailed by the birds with evident signs of joy. "Of their feelings he seemed to be perfectly aware, and he made his reply to them in a similar strain. Their mutual congratulations being over, they all three set to work."

As an instance of seemingly concerted action between animals of different species, Jumbo, the Newfoundland to which I have previously referred, is on excellent terms with two cats who live in the same house. Jumbo is too heavy to jump upon the table, but he has been observed watching below while the cats have sprung on to it, and thrown down fish to him, which the three have afterwards discussed together.

According to Romanes, dogs communicate with one another by gesture and tones of barking; of dogs above the average of canine intelligence he believes that "the gesture they invariably employ is a contact of heads with a motion between a rub and a butt. It is quite different from anything that occurs in play, and is always followed by a definite course of action."* He illustrates this point by the following example. "A Skye terrier (not quite pure) was asleep in the room where I was, while his son lay upon a wall which separates the lawn from the high road. The young dog when alone would never attack a strange one, but was a keen fighter when in company with his father. Upon the present occasion a large mongrel passed along the road, and shortly afterwards the old dog awoke, and went sleepily downstairs. When he arrived upon the doorstep his son ran up to him and made the sign just described. His whole manner immediately altered to that of high animation. Clearing the wall together the two animals ran down the road as terriers only can when pursuing an enemy. I watched them for a mile and a half, within which distance their speed never abated, although the object of their pursuit had not from the first been in sight." The following interesting case shows how a dog communicated news of disaster to its master, and afterwards aided him to avert its consequences. Mr. A. H. Browning, after looking at a litter of young pigs, inadvertently left the door of the sty open so that all the pigs escaped. His attention was called to his dog, which approached in a great state of excitement, *not* barking (he seldom barks), but whining and performing all sorts of antics (in a human subject, Mr. Browning observes, "I should have said 'gesticulating'"). The herdman and Mr. Browning returned to the sty; they caught but one pig and put him back; no sooner had they done so than the dog ran after each pig in succession, brought him back to the sty by the ear, and then ran after another until the whole number were again housed.

OUR HOUSEHOLD INSECTS.

By E. A. Butler.

COLEOPTERA (*Continued*).

AN insect, allied to *Anobium domesticum*, and formerly referred to the same genus, but now known as *Xestobium tessellatum*, has often been a source of terror to the superstitious, by whom it is known as the Death Watch. It is a stout, reddish-brown beetle (Fig. 1.), sprinkled with small patches of pale hairs; but, while very similar in shape, it is a great deal larger than any of the Anobia proper, sometimes attaining a length of ⅓ inch and a corresponding obesity.

The ticking, or clicking, noise that is sometimes heard in old houses, and has so often been considered to portend the death of some inhabitant of the dwelling within the year, is caused by these insects striking the wooden walls of their burrows with their hard head or jaws, and is generally supposed to be a love-call, for when one has made some four or five taps in quick succession, it pauses, and is immediately answered by another in some other quarter. The tapping is not sufficiently loud to attract much attention in the daytime, when so many other noises are going on; but

Fig. 1.—Xestobium tessellatum.

in the stillness of the night, when every sound that does occur seems magnified to an enormous degree, this regular succession of knocks, proceeding from no apparent physical cause, might, on the principle of *omne ignotum pro mirifico*, easily awake apprehension in the minds of the ignorant and superstitious, already by habit accustomed to look out for "omens," "visitations," "warnings," and such like; and it is, perhaps, not altogether to be wondered at that amongst those engaged in nursing the sick, who, from the stillness of the sick-room, and the fact of their being night-watchers, would generally be the most likely to meet with such experiences, some should have seen in these mysterious tappings a confirmation of their own anxious forebodings with respect to the loved ones of their charge. But the application of a little practical common sense soon dispels these illusions, and demonstrates the very material nature of the omens, or, as Swift quaintly puts it:—

> A kettle of scalding hot water ejected
> Infallibly cures the timber affected;
> The omen is broken, the danger is over,
> The maggot will die, and the sick will recover.

In the Philosophical Transactions for 1698 is a curious paper entitled, "An Account of the Scarabæus Galeatus Pulsator, or the Death Watch, taken August, 1695, by Mr. Benjamin Allen." It is accompanied by an enormously magnified figure of the insect, and from this and the description, it is evident that the Scarabæus is none other than our present acquaintance, and the article appears to be the earliest detailed scientific account of the insect. The writer commences in a somewhat spasmodic and inconsequential style:—"The second Animal I observ'd is a Death Watch: I have taken some before this, it is that which makes a noise resembling exactly that of a Watch; it is faithfully the very same, and liv'd Four Days with me, beating exactly, for I took two, I suppose one was the Female, that is only conjecture." He is a little bit sceptical as to the prophetic character of the tappings, saying:—"This small Beetle . . . being rarely heard, and not known, has obtain'd the name of a Death Watch, which yet I have known to be heard by many, where no mortality follow'd, and particularly by myself, who have taken Two of the same, Seven years since, without any Death following that Year." A quarter of a century later, another observer, Mr. Hugh Stackhouse, communicates a further note on the subject, wisely abstaining, however, from

* "Animal Intelligence," p. 445.

any reference to the theory of prognostications. He prefaces the article by an account, almost needlessly minute and circumstantial, of the way in which he gradually tracked the insect by its ticking, till he found it in the seat of a rush-bottomed chair. Here he watched the little creature at work, and was so delighted with his discovery that he "called up others to see it beat, which they did, not without admiration." He then proceeds to describe the "manner of its beating." In its helmet-like thorax—or galea, as he calls it—he sees "a very notable and providential defence against such falls as are frequent in rotten and decayed places." He transferred his captive to a box, and kept it alive about a fortnight, but was unable to get it to beat again during its captivity, apparently through not knowing how to induce the action, for in the *Entomologists' Monthly Magazine* for 1866, the late Mr. F. Smith states that he had no difficulty in getting some that he kept to tick whenever he wished, by simply tapping five or six times with a lead pencil upon the table close to the box in which they were confined. They very shortly answered the summons; raising themselves on their front legs, they commenced bobbing their heads up and down, rapidly tapping with their mandibles on the bottom of the box. The number of taps on each occasion was either four or five, usually the latter.

The Dutch naturalist, Swammerdam, who flourished during the latter half of the seventeenth century, speaks in his "Book of Nature," of an insect, no doubt either the present or an allied species, which "makes a continual noise in old pieces of wood, walls, and ceilings, which is sometimes so loud that upon hearing it, people have been persuaded that nocturnal hobgoblins, ghosts, or fairies wandered about them." He adds, "I think this may be properly called Sonicephalus, or Noisy-headed Beetle."

A totally different insect, known generally as the "book-louse," has also been credited with being the producer of the Death Watch tappings. It is an extremely minute, soft-bodied creature, belonging to the order Neuroptera, and is a very common inhabitant of houses. But it does not seem possible that a creature of such delicate structure should create these noises; however, we will recur to this subject when, later on, we come to the consideration of the insect in question.

Xestobium tessellatum, being so much larger than the Anobia, is, of course, far more destructive to timber, if allowed to have full scope for its powers. Spence speaks of the whole of the woodwork of a house in Brussels requiring to be renewed in consequence of its depredations, and states that he was informed that this was no uncommon occurrence there, the inhabitants calmly acquiescing in the attacks of their tiny foe, through ignorance of any plan of exterminating it, or at any rate checking its ravages. Like most wood-feeders, it is long-lived in the larval state. Westwood kept one for three years before it attained its perfect form.

(To be continued.)

Public Works in France.—The expenditure of the French Government upon public works in the six years ending with 1884, inclusive, was £90,049,139.

Royal Victoria Hall and Coffee Tavern.—An excellent variety entertainment has been given at the above hall during this week, the usual science lecture and ballad concert having been discontinued in its favour. These will, however, be resumed next week, and continued during the rest of the season. The science lecture, on April 21, will be given by Dr. P. H. Carpenter, on "Iceland," illustrated with oxyhydrogen light. The management desire to announce that the seating of the hall is being altered and improved, so that every one in future will be equally well able to see all that is taking place on the stage.

FIRST STAR LESSONS.

By Richard A. Proctor.

THE constellations included in the twenty-four maps of this series are numbered throughout as follows (the names being omitted on the maps, to clear these as far as possible from all that might render the star-grouping less distinct) :—

1. *Ursa Minor*, the *Little Bear* (*α*, the *Pole Star*).
2. *Draco*, the *Dragon* (*α*, *Thuban*)
3. *Cepheus*, *King Cepheus*.
4. *Cassiopeia*, the *Lady in the Chair*.
5. *Perseus*, the *Champion* (*β*, *Algol*, famous variable).
6. *Auriga*, the *Charioteer* (*α*, *Capella*)
7. *Ursa Major*, the *Greater Bear* (*α*, *β*, the *Pointers*).
8. *Canes Venatici*, the *Hunting Dogs* (*α*, *Cor Caroli*).
9. *Coma Berenices*, *Queen Berenice's Hair*.
10. *Boötes*, the *Herdsman* (*α*, *Arcturus*).
11. *Corona Borealis*, the *Northern Crown*.
12. *Serpens*, the *Serpent*.
13. *Hercules*, the *Kneeler*.
14. *Lyra*, the *Lyre* (*α*, *Vega*).
15. *Cygnus*, the *Swan* (*α*, *Arided*; *β*, *Albires*).
16. *Pegasus*, the *Winged Horse*.
17. *Andromeda*, the *Chained Lady*.
18. *Triangula*, the *Triangles*.
19. *Aries*, the *Ram*.
20. *Taurus*, the *Bull* (*α*, *Aldeburan*; *η*, *Alcyone*, chief *Pleiad*).
21. *Gemini*, the *Twins* (*α*, *Castor*; *β*, *Pollux*).
22. *Cancer*, the *Crab* (the cluster is the *Beehive*).
23. *Leo*, the *Lion* (*α*, *Regulus*).
24. *Virgo*, the *Virgin* (*α*, *Spica*)
25. *Libra*, the *Scales*.
26. *Ophiuchus*, the *Serpent Holder*.
27. *Aquila*, the *Eagle* (*α*, *Altair*).
28. *Delphinus*, the *Dolphin*.
29. *Aquarius*, the *Water Carrier*.
30. *Pisces*, the *Fishes*.
31. *Cetus*, the *Sea Monster* (*o*, *Mira*, remarkable variable).
32. *Eridanus*, the *River*.
33. *Orion*, the *Giant Hunter* (*α*, *Betelgeux*; *β*, *Rigel*).
34. *Canis Minor*, the *Lesser Dog* (*α*, *Procyon*).
35. *Hydra*, the *Sea Serpent* (*α*, *Alphard*).
36. *Crater*, the *Cup* (*α*, *Alkes*).
37. *Corvus*, the *Crow*.
38. *Scorpio*, the *Scorpion* (*α*, *Antares*).
39. *Sagittarius*, the *Archer*.
40. *Capricornus*, the *Sea Goat*.
41. *Piscis Australis*, the *Southern Fish* (*α*, *Fomalhaut*).
42. *Lepus*, the *Hare*.
43. *Columba*, the *Dove*.
44. *Canis Major*, the *Greater Dog* (*α*, *Sirius*).
45. *Argo*, the *Ship*.

THE EVOLUTION OF THE SENSE OF BEAUTY.*

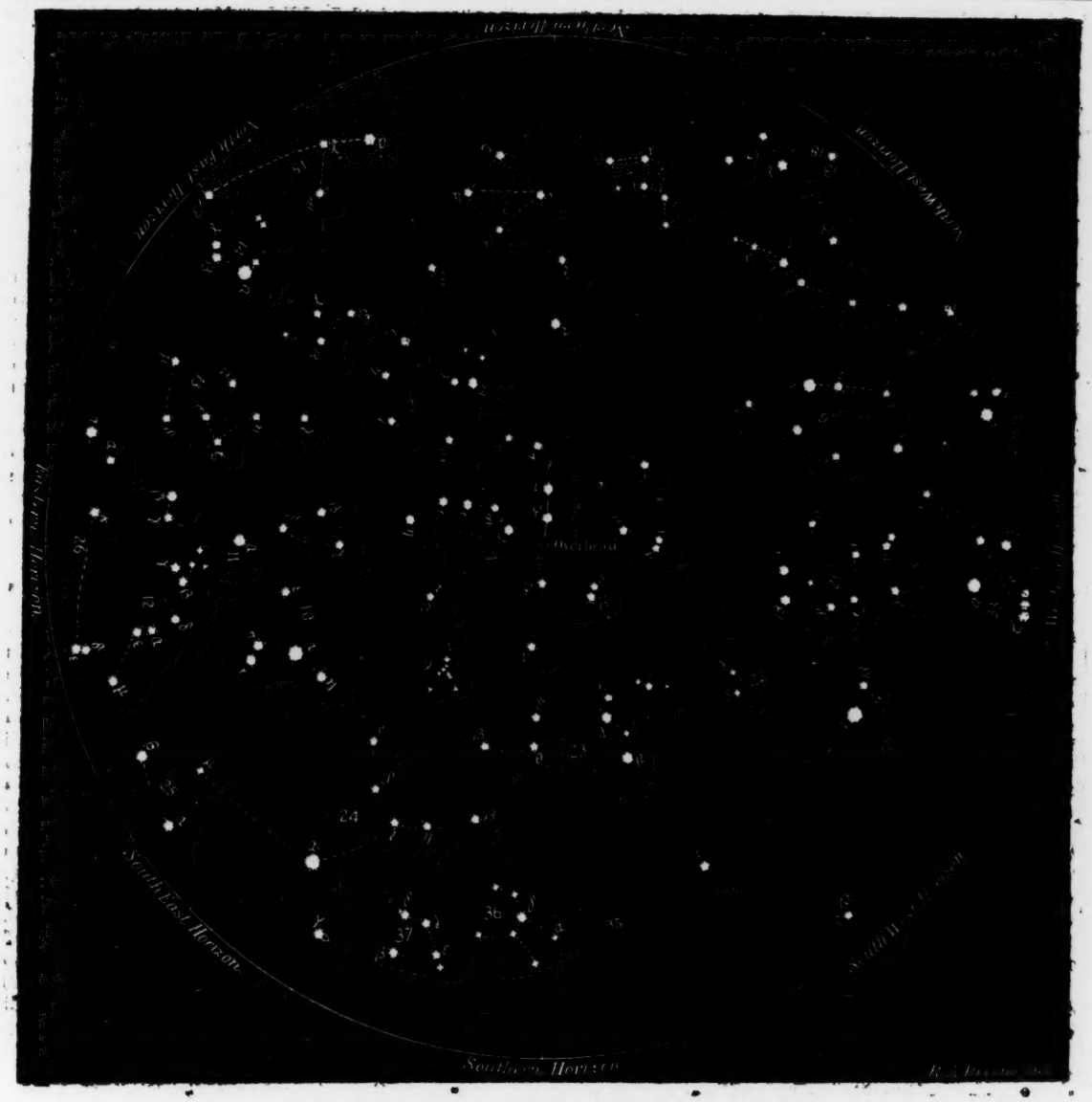
By Constance C. W. Naden.

I.

"WHAT is Beauty?" This is one of those enigmas which the world of to-day is almost ready to give up. A quality which may with equal truth be predicated of a humming-bird and of the Parthenon, of a daffodil and of the Venus de' Medici, may well perplex the most skilful æsthetic analyst. Besides, esoteric art-critics occasionally make confusion worse confounded by finding beauty where laymen find pure and simple ugliness, and by treating everyone who worships not with them as a heathen man and a publican.

Thus excommunicated, whither shall we turn? The easiest plan, perhaps, were to found a sect of our own, and name ourselves, not Pre-raphaelites, but Pre-adamites. Can we not see in imagination an enthusiastic professor of Fine Arts, holding in his hand a fragment of ivory scratched with a portrait of the mammoth, and dilating upon the truth, the sincerity, the absolute rightness of this primitive masterpiece? Can we not hear him eloquently exalt the Cave-man above his degenerate descendants, who debase

* Read at a meeting of the Mason Science College Union, Nov. 21, 1884.



NIGHT SKY FOR APRIL (First Map of Pair),

Showing the heavens as they appear at the following hours:—

April 3 at 10½ o'clock.	April 11 at 9½ o'clock.	April 18 at 9½ o'clock.
April 7 at 10 o'clock.	April 14 at 9½ o'clock.	April 22 at 9 o'clock.

the pure outline with impious accessories of colour and of shade? Can we not prospectively triumph in his denunciation of unutterable woes upon a generation which will neither understand nor emulate the calm, severe majesty attained by their Palæolithic ancestors? Yes, we must found a sect.

But, to avoid waste of time, we can first assume some rough practical answer to the question, "What is Beauty?" We know, or think we know, beautiful objects when we see them; and that, for the present, shall be enough. Leaving entirely out of consideration the beauty of sound, of sentiment, of character, let us provisionally define beauty as that quality, or assemblage of qualities, which pleases the eye; putting aside, for the present, the further question, "But *what* eye?"

Suppose, instead of pressing on in this direction, we adopt the historical method, and ask, "How did beauty come to exist?" Yet, even under this seemingly modest query, lurks one of those assumptions which are apt to persist in the most highly-developed intellects as rudiments of a pre-scientific age, much as the human body retains vestiges of a tail and a pointed ear. The assumption is that beauty exists as something definite and objective; something which might maintain its quality in the absence of eyes to see or mind to appreciate; something which, at all times, in all places, to all orders of intellect, must be

intrinsically the same. Yet, if there be any inhabitants of the planet Mars, possessing powers of vision and taste in art, it is probable, considering the conditions under which they must live, that they would regard Titian's Venus or Raphael's Madonna della Sedia as the portrait of a monstrosity. And there would be no reason, other than planetary patriotism, for rating our own taste higher than theirs. We need not go so far as Mars for an example; save that an art-critic might be moved to a scornful smile were the opinion of any terrestrial mortal urged against his own. Therefore, we may pass lightly over the familiar examples of the Botocudos, with their perforated lower lips, distended by a disc of wood; the Malayans, with their filed and blackened teeth; the American Indians, with their red paint and tattooing; and the Cochin Chinese, who speak with disdain of white teeth like a dog's, and a complexion like potato-flowers.

But to return to our problem, which must be formulated a third time. This, perhaps, is better: "What is the genesis of the *sense* of beauty, and in what manner has it been evolved?" Now we shall offend no one, saving possibly some dogmatist of the "*Quod ubique, quod semper, quod ab omnibus*" school, and even he may listen with some languid interest if the question be worded thus:—"What has caused us to take pleasure in various classes of objects, natural and artificial?" Even supposing our æsthetic views to be utterly wrong, the history of their development may be as instructive as the history of the rise and progress of any other heresy.

First, it is as well to indicate in a general way the nature of the æsthetic pleasures. All philosophers, from Aristotle to Herbert Spencer, have insisted on their necessarily disinterested character; and they may be defined as "those pleasures which are shareable; which are not directly connected with essential life-serving function; and which do not involve muscular exertion on a large scale, or of great intensity."

It is also possible to classify the materials with which the sense of visual beauty has to deal.

These are *colour* and *form*.* A colour which pleases may be bright, or rich, or delicate. A combination of colours may charm by contrast or gradation. A line may please by straightness or curvature; a combination of lines by symmetry or variety, or by the two united.

But it by no means follows that we are delighted by *all* bright, rich, delicate, contrasted, or gradated colours; by *all* straight or curved lines, or symmetrical or varied shapes; and it does not yet appear why they should ever give us delight.

However, we will not begin with our exalted selves. Let us "consider the lilies of the field," and "behold the fowls of the air." They are far more likely to be helpful companions than the most accomplished lounger through Italian picture-galleries.

The "lilies of the field" and the "fowls of the air" are to guide us in our search for the well-springs of the sense of beauty. And, first, we take the flowers. Here the inquiry splits into two parts. How have they gained their varied shapes, their delicacy of texture, their brilliancy of colour? And how is it that these qualities give us pleasure?

The latter question must be postponed for a time, but the answer to the former is becoming an evolutional commonplace. Look, for instance, at the broad yellow sepals of the marsh marigold; look at the wastefully-beautiful water-lily; or, better still, look at the quaint form and economical adornments of the lotus. Notice how she leaves a space in her stamen-tube through which the bee can suck honey, and spreads her yellow wings to give him an alluring seat, but a seat so cunningly contrived that he cannot alight on it without pressing open a casket of pollen and receiving some of its grains upon his breast. Directly he flies away, the casket shuts with a spring. Now, brightness of colour in flowers tends to what we call beauty, and clever mechanical arrangements may or may not have the same tendency; but the important point to notice is, that both have the same object. The flower wants to send her golden treasure to another flower, and, not being able to travel herself, employs and pays a commercial traveller. Are we to suppose that the bee finds the lotus *beautiful*, and is therefore attracted? No, but the bee finds the lotus conspicuous, and learns to regard this particular kind of conspicuousness as an index of sweetness. As we shall see, bright colour does probably produce some faint gratification of the bee's senses, but doubtless the agreeable sensation aroused in the bee by purple or golden petals is chiefly of the same kind as the agreeable sensation aroused in the "*bonâ-fide* traveller" by the sign of the White Lion. The lilies of the field, then, have gained their charm simply by making themselves conspicuous—primarily for their own benefit, and secondarily for that of the bee; and the bee approves these charms from the most mercenary of motives.

Turn we now to the fowls of the air. Here, also, we will take up the first part of the inquiry, leaving the second for future consideration.

How did the birds obtain their fine feathers? They obtained them by *courtship*. How the *Rupicola crocea* capers about, spreads his beautiful orange wings, and opens his tail like an orange fan, that so he may win him a bride; how the gold pheasants "expand and raise their splendid frills," and even "twist them obliquely towards the female, on whichever side she may be standing," at the same time turning "their beautiful tails and tail-coverts a little toward the same side"; how the peacock shows similar good judgment in displaying to the best advantage, not only his train, but his rich blue throat and breast; is it not written in the book of Darwin, in the book of the Chronicles of the Descent of Man? Is it not likewise written how the fancy of the female birds has continually been caught by accidental variations of form or colour; how, generation after generation, they have consistently chosen the more ornamented males, and thus put a premium on beauty—a prize offered to much better purpose than that golden apple which bred dissension among the gods, and all the woes of Ilion?

But we do not learn *why* the female prefers a bright-hued mate to a sombre-hued mate, or a husband who sports eccentrically shaped tail-feathers to one with a tail of the ordinary orthodox cut. She is not guided by utilitarian principles, for the variations which she approves are not usually helpful in the "struggle for existence." Sometimes, indeed, they are absolutely disadvantageous. Why should any sane and sensible bird-bride prefer a bird-bridegroom who finds his streaming wings or tail-feathers as much in his way as a newly-presented courtier finds his sword! The African night-jar, the Argus pheasant, and the widow-bird are among those who in this way sacrifice comfort and safety to magnificence. How can we explain the fact that a game hen admires her hero for the possession of an ornament which adds to the dangers of battle, because it offers so easy a hold to his enemy's beak, and which, indeed, is always trimmed away by cock-fighters? Shall we set down her conduct to mere feminine caprice, or believe her to be a votary of "art for art's sake?"

"It is easy," perhaps you say, "to explain the bird's

* Light and shade, for present purposes, are included in colour-contrast, and gradation.

liking for decorations. She likes them, just as we do, because they are beautiful." Yes, *you* think them beautiful, but that only means that they please *your* eyes. Be sure that her taste is not guided by yours. "No," you hasten to explain, "they are beautiful to *her*." Well, that only means that they please *her* eyes; so you have managed to explain that she likes them—because she likes them. That is what is libellously called a woman's reason, and so may do well enough for a female bird; but it will not do for the would-be analyst of that bird's psychology. Nor can we seriously believe that the hen could not see the cock well enough without his dangerously beautiful comb, or that the pea-hen would not recognise her mate unless he advertised himself by a gorgeous but cumbrous "train." Besides, conspicuousness to friends involves conspicuousness to enemies.

CHAPTERS ON MODERN DOMESTIC ECONOMY.

XXII.—THE FRAMEWORK OF THE DWELLING HOUSE.

STRUCTURAL EXAMPLES (*continued*).

THE DISPOSAL OF HOUSEHOLD REFUSE.

OF disconnecting traps between the house-drain and the main sewer there are many varieties. In our last chapter we mentioned "Potts's Edinburgh Air Chambered Trap" as one which fulfilled all the requirements of an efficient protector against the entry of sewer-gas into the domestic drain, and pointed out by means of that example, that adequate disconnection can only be obtained through:—(A) a very carefully-adjusted bend of the pipe to form a perfect water-seal, which shall afford the utmost facility for the passage of waste matters sewer-wards. (B) Ventilation on the house-side of the trap to effect a passage for fresh air through the house-drain and soil-pipe. (C) Ventilation on the sewer-side of the trap for relief of undue pressure, and for purposes of inspection when required.

Now, there are many appliances in the market which thoroughly fulfil all the requirements above noted, and which have been each designed to meet the wants of individual cases of frequent occurrence. One of the simplest and best forms is "Hellyer's Patent Interceptor," a diagrammatic representation of which we give here in Fig. 18.

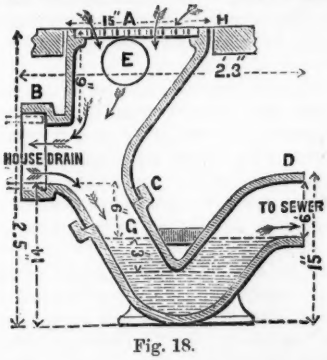


Fig. 18.

The house-drain is shown discharging into a dip or U-shaped trap, from whence the waste materials are forced into the sewer in virtue of the law of hydrostatics. Fresh air finds access through a grating into a chamber on the house side of the trap, and into this compartment the discharge from yards and rain-water pipes can enter. We strongly recommend "Hellyer's Interceptor," as manufactured by the eminent firm of Doulton & Co., to the notice of all householders and builders of artisans' cottages and abodes of a low rental value, since it is inexpensive and the most perfect apparatus of its kind.

The "Kenon Air Chamber Floor and Trap" is, without doubt, a *chef d'œuvre* of modern times. We are indebted to Messrs. Doulton & Co., of Lambeth, for the accompanying woodcut, Fig. 19, which shows a brickwork manhole,

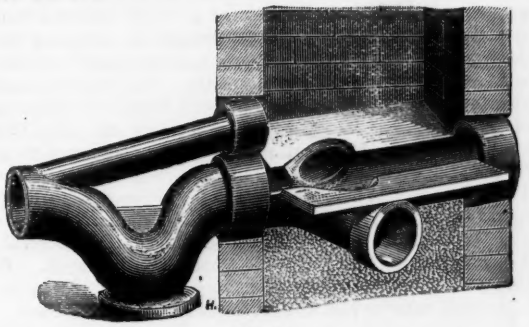


Fig. 19.

at the base of which an open channel, the original idea of the distinguished engineer, Mr. Rogers Field, is shown. The contents of the house-drain flow through this channel into a U-shaped dip-trap, the sewer side of which is provided with an inspection arm, ordinarily plugged, which opens into the manhole or air-chamber. The entire apparatus is made in one solid piece of glazed, imperishable stoneware, and may therefore be said to claim a foremost place amongst disconnecting appliances.

"Mansergh's External House-Protecting Drain Trap," a section of which we give in Fig. 20, explains itself sufficiently to show that the contents of the inlet, after passing through the water-seal, are ejected through a duly-ventilated outlet, whilst a grating above permits of the entry of yard and other waste waters. It is an extra domestic appliance of the first importance in a well-regulated abode.

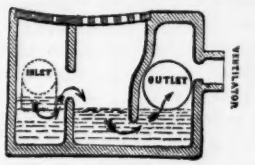


Fig. 20.

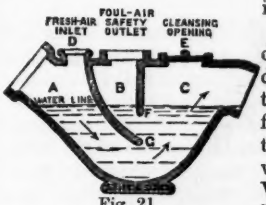


Fig. 21.

It has been contended that a double trap with an intermediate ventilating opening between them is somewhat superfluous, since it pre-supposes that the sewer or cesspool is very insufficiently ventilated. We are of opinion that the forethought here condemned is of vital importance, since all our observations go to show that efficient ventilation of sewers is a thing of the future, and that aëration of cesspools is practically a nonentity. We are, therefore, constrained to give prominence to the invention of Richard Weaver, Esq., C.E., F.C.S., and Messrs. Jas. Stiff & Sons' "Registered Intercepter Sewer-Air Trap" (Fig. 21).

"The Intercepted Trap" is intended to be fixed at any convenient and easily accessible point between the house and the street-sewer. Stoneware ventilating pipes, from B and D, should be carried just above the ground level. The mephitic air from the sewer is effectually intercepted by means of the two water-seals, F and G (the latter being much the stronger), with intermediate ventilation. Under

ordinary circumstances the foul air will be confined to chamber C; but, should the pressure be strong enough to force the trap at F, the sewer-gas will at once escape into the open air through chamber B, by means of the ventilating pipe, as described above. A second and much stronger trap, at G, effectually excludes all poisonous gases from chamber A, which forms the only avenue to the house. The diaphragm G is so constructed that the sewage from the house is discharged directly into the trapped chamber C, beyond the point of communication with the open air. By this arrangement the necessary ventilation of the trap is effected with a minimum of contamination to the surrounding atmosphere. All traps are made with the aperture D. It is not only useful for cleansing, but should always be employed as a fresh air inlet, thus securing a constant current of pure air sweeping through the house-drain and soil-pipe, and escaping above the roof of the house. When the house-drain is deep, a drain-pipe should be conducted vertically from the cleansing opening E to about 9 in. below the ground level, then carefully closed with the disc-plate and covered with earth. By means of a long-handled ladle any subsequent obstruction in the trap may be removed without trouble or expense.

The exact description here given of Messrs. Stiff's apparatus is the best testimonial we can venture to accord to any disconnecting trap. It speaks for itself.

Editorial Gossip.

The march number of that excellent American astronomical serial *The Sidereal Messenger*, contains a very interesting abstract of a paper by Professor Seeliger, of Munich, "On the Distribution of the Stars in the Northern Hemisphere." I note this here because Professor Seeliger's researches so entirely corroborate the views consistently maintained by the conductor of this Journal as to the structure of the physical universe, and show that the "cloven disc" theory of the Milky Way is absolutely baseless and untenable. It may reasonably be hoped that the too-familiar diagram illustrating this said "disc" will now disappear from popular books on astronomy at once and for ever.

Everyone who is anxious that England should retain her position of pre-eminence as a manufacturing nation will be gratified to learn from the "Report to the Governors of the City and Guilds of London Institute for the Advancement of Technical Education," of the continued success of the Finsbury Technical College and of the South London Technical School of Art. Whether, though, as much pleasure will be derived by impartial people from learning that the hat is still orbitating for that charming job, "The Central Institution" at Brompton, may reasonably be a question for discussion. There is something sad in the reflection that the representatives of the great City Guilds, who have given so lavishly in furtherance of the laudable purpose of educating our artificers, should have been so led by the nose by a comparatively few astute people as to erect this "Central Institution" in what one of the contributors to these columns has elsewhere called "that focus of snobbery and jobbery—South Kensington." In their desire to be genteel, the contributories have wholly lost sight of the fact that their money is being artfully extracted from their pockets to provide situations for the parasites of the Science and Art Department, I suspect that it will not be long ere the Livery Companies have their eyes rudely opened to the mistake they originally made in suffering their central establishment itself to be erected in such a locality, and its virtual control to pass out of the hands of those whose sole business is to provide the money.

I have received a copy of an address delivered at the Manchester Medical Society on the 4th of last February, by the President, Mr. Walter Whitehead, which contains some statistics of so startling a character as to deserve the serious attention, not only of every pathologist and man of science, but of every man and woman in the kingdom. Briefly, if the Reports of the Registrar-General are trustworthy, it would seem that while, during the year 1849, 4,807 persons died from cancer in England and Wales, by 1882 the number of such deaths had reached the terrible total of 14,057! In point of fact, during the last ten years only the death-rate from cancer has advanced 36 per cent. Mr. Whitehead inclines to the opinion that, as this most terrible disease is endemic in certain localities which he specifies, the physical geography of a place must enter as one factor into its production. The whole subject, however, is, unfortunately, very obscure, and is assuredly one demanding the most instant and searching investigation.

On this day thirty-seven years occurred the famous Chartist fiasco, when Mr. Feargus O'Connor and his mob, who were going to march in their unnumbered thousands through the streets of London, and make a descent upon the House of Commons with their monster petition, found that discretion was the better part of valour, and gracefully retired with their tails between their legs. Now this all happened well within the recollection of very many who will read these lines, and yet how strangely changed in externals are both London and its inhabitants since April 10th, 1848! New Oxford-street had, it is true, just been cut through the quondam "rookery" of St. Giles's; but the site of Victoria-street, with its stately mansions on each side, was then a huddled group of foul streets in which the vilest characters swarmed. The Law Courts were as yet undreamed of, and Temple Bar impeded the traffic where that artistic abortion, the Griffin, at present offends every cultivated eye. The Thames Embankment now covers what was then the muddy coal-barge hidden foreshore of the river; and the present artistic Blackfriars Bridge occupies the site of the older and less ornamental structure over which Feargus O'Connor & Co. did *not* march. Charing Cross Railway Bridge spreads over much more than the area of Brunel's Hungerford Suspension Bridge, and the Cannon-street one was not yet. Two steep and dangerous hills met where the Holborn Viaduct now runs as a broad and level road, and the present quasi-fashionable region of South Kensington was a series of nursery-gardens. Men wore real "stove-pipe" hats, long hair! what were called "Paletots," double-breasted waistcoats, and "Joinville ties," huge flat straps of satin with fringed ends, round their throats; while moustache, save among cavalry men, was utterly unknown. Ladies appeared in curls, and small bonnets of the coal-scuttle order of architecture; and that very nasty imitation of a repulsive deformity, the "bustle" (I fancy, but am not sure, that it is now known as a "dress-improver"), was just coming in. I should, perhaps, in candour admit that I am indebted to Cassell's "Old and New London" for my topography, and to the caricatures of the late John Leech for my fashions.

The captive balloon introduced a fortnight since at Suakim ascended to a height of 200 feet. It was made of goldbeater's skin, contained 7,000 cubic feet of gas, was 23 feet in diameter, and weighed 90 lb. It was charged with gas made at Chatham and taken out in a reservoir in a compressed state.

THE FACE OF THE SKY.

From April 10 to April 24.

By F.R.A.S.

ALTHOUGH sun-spots and other indications of solar disturbance continue slowly to decrease both in number and magnitude, no opportunity should be lost of scrutinising the Sun's disc. The night sky will be found delineated in Map IV. of "The Stars in their Seasons." Mercury may be still seen after sunset when these notes begin, but, from his approach to the Sun, daily gets into a worse position for observation. Towards the time of their termination he will be quite invisible. Venus, too, as a morning star, and approaching the sun pretty rapidly, is very badly placed for the observer. Mars is invisible. Jupiter should be looked for as soon after dark as may be; as, though he does not set, even at the end of the fortnight, until after 3 a.m., he is pretty low down by midnight. The phenomena of his Satellites continue to provide the student with a series of interesting spectacles. To-night (10th) the egress of the shadow of Satellite II. will happen at 8h. 40m.; and Satellite IV. will disappear in eclipse at 10h. 13m. 51s. On the 12th, the transit of Satellite I. will begin at 11h. 22m., and that of its shadow 25 minutes after midnight. On the 13th, Satellite I. will be occulted at 8h. 29m. p.m.; to reappear from eclipse at 11h. 50m. 22s. On the 14th, the ingress of the shadow of Satellite I. will occur in twilight at 6h. 54m.; the egress of the Satellite casting it at 8h. 9m.; while the shadow itself will leave the face of the planet at 9h. 13m. Later, at 10h. 43m., Satellite III. will be occulted. On the 15th, Satellite II. will be occulted at midnight. On the 17th, the shadow of Satellite II. will enter on to Jupiter's limb at 8h. 21m. At 9h. 2m. p.m. Satellite II. itself will quit the planet's disc, as will its shadow afterwards at 11h. 16m. On the 18th the Egress of the shadow of Satellite III. takes place at 8h. 43m. At 11.36 Satellite IV. will pass off the face of Jupiter. This phenomenon should, for the reason so often given in this column, be carefully noted by the observer. On the 20th, Satellite I. will be occulted at 10h. 19m. p.m. On the 21st perhaps the transit of Satellite I. may be seen to begin in the twilight at 7h. 39m. Its shadow will follow it on to the limb of the planet at 8h. 49m. At 9h. 59m. the Satellite will leave Jupiter's opposite limb, as will its shadow subsequently at 11h. 8m. On the 22nd, Satellite I. will reappear from eclipse at 8h. 14m. p.m. Lastly, on the 24th the Transit of Satellite II. will begin at 8h. 34m., and that of its shadow at 10h. 57m. The Satellite leaves the planet's disc at 11h. 30m., its shadow not until the next morning. Saturn has left us until the autumn. Uranus continues to be well placed for the amateur observer during the convenient hours of the night. The planet continues to move almost insensibly in the direction of β Virginis ("The Stars in their Seasons," Map V.) Neptune is invisible. The Moon will be new at 5h. 51m. 4s. a.m. on the 15th, and enter her First Quarter at 11h. 20m. 2s. p.m. on the 21st. Four occultations of fixed stars will happen at convenient hours during the period covered by these notes. First, on the night of the 20th the 3½th mag. Star λ Geminorum will disappear at the dark limb of the Moon at 10h. 59m. at an angle of 187° from her vertex; reappearing at her bright limb at 11h. 20m. at a vertical angle of 232°. On the 22nd B.A.C. 3122 a Star of the 6½th mag. will disappear at the dark limb at 9h. 4m. p.m., at a vertical angle of 127°. Its reappearance will take place at 10h. 4m. at her bright limb, at an angle of 255° from her vertex. On the 23rd, π Leonis, a 5th mag. star, will disappear at 6h. 46m. at the moon's dark limb, at an angle from her vertex of 14°. Its reappearance at her bright limb will occur at 7h. 42m., at an angle of 290° from her vertex. Lastly, on the night of the 24th, d Leonis, also a 5th mag. star, will disappear at the dark limb of the moon, at 11h. 7m., at a vertical angle of 135°. The star will reappear at her bright limb at 11h. 58m., at an angle from her vertex of 238°. Starting to-day from a point on the confines of Capricornus and Aquarius, the moon travels through the last-named constellation, and at 11 a.m. on April 12 crosses into Pisces. Her passage through this great straggling constellation occupies until 10 a.m. on the 15th, when she passes into Aries. This she quits at 1 a.m. on the 17th for Taurus, and in her passage across it arrives at noon on the 19th at the narrow northern strip of Orion running up into it. In a little more than 11 hours she has crossed this and emerged in Gemini. At 2 p.m. on the 21st she crosses the boundary into Cancer. She leaves Cancer for Leo at 2 a.m. on the 23rd. Travelling through Leo, she, at 7 a.m. on the 24th, descends into Sextans, to re-emerge in Leo at 5 o'clock the same afternoon. She is still in Leo when our notes terminate.

The expenses in connection with lighthouse illuminants experiments recently carried out amounted up to the end of November last to over £10,000.

"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

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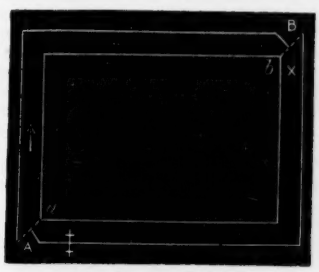
THE DUAL BRAIN AND DREAMING.

[1661]—The following facts may be interesting to you or your readers in connection with the question of the duality of the brain. Some years ago, when I was about thirty-five years of age, I dreamed that, as a boy of about twelve to fourteen, I was out in the country with my father, who was driving a horse and gig. Our road was through fields, and I had to get out to open each gate that we passed through. At last we came to a square field of ripe, standing corn, with a narrow road, only just the width of the gig, all round it, close to the inner sides of the walls, as shown in figure. When I opened the gate at A, it fell back to a, thus completely blocking the road to the right, as the arrangement of the gatepost and hinges did not allow it to fall back even with the wall at ‡.



We were, therefore, obliged to drive round the field in the direction of the arrow, in order to make our exit at the gate B. But, when I opened that gate, I found that it fell back to b, and thus completely blocked our road. My father then said to me, "Well! what shall we do now, Harry?" I answered, "You will have to back the horse all the way round the field, and so through this gate while I hold it open." My father replied instantly, "Nonsense, there is a better way than that. Close the gate." I did so, not understanding at all what he meant to do, and then he drove round the corner of the road to a position at ×, so as to be just clear of the gate, which he then bade me to open again. I did so, and he backed the horse and gig those few yards into the next field, which was a pasture. When I saw what he did, I was much struck with the superiority of my father's simple and ready device to my own roundabout and troublesome one.

I think there are many remarkable features in this case. (1) There was such a dramatic fitness in the part played by each of us. I was a dreamy, unobservant, unpractical boy, and my father was a quick-witted, inventive, practical man of business. (2) At a maturer age, when I had fully developed the observant and practical qualities in which as a boy I was particularly deficient, I yet unconsciously acted mentally in a bungling, puzzleheaded way, as if still in my boyish condition. (3) The same brain which, in inventing this stupid plan, acted so consistently with the part it was playing as a boy's brain, was yet capable at the same time of seeing its own stupidity, and of inventing instantly a better plan consistent with its assumption of the character and mental powers of a clever man. (4) Although the same brain invented the superior plan which it attributed with dramatic propriety to my

father, yet the process of inventing it, and the knowledge of it when invented were so completely outside the consciousness of myself as the boy in the dream, that when my father carried out his plan (for he did not explain it beforehand) I only then learned what it was by seeing him do it, and I was as much surprised as if it were really the invention and act of another person quite distinct from myself.

Here, then, we have practically the brain of one and the same person constructing, setting, and explaining a puzzle which it is at the same time unable to find out. H. H. M.

INFINITY.

[1662]—Your correspondent "Hallyards," in letter 1653, referring to what are called the "infinitely great," and the "infinitely small," writes:—"Is it not probable that there is no single orb much bigger than Sirius, and, if so, there seems a limit to the size of molecules on one side; must there not be one on the other?"

On what ground does he maintain the probabilism that Sirius is among the largest of orbs or molecules? It may be usual for astronomers, speaking in a general way, to refer to it as such, but in a discussion in which the stars and planets are brought into comparison with the smallest known particles of matter (namely, the "ultimate atoms" in chemistry), it would be difficult, I think, to assign a reason for such a probability.

Let us imagine a rational being contained in some obscure planet, the system—or we may say the entire universe—of which forms merely a single atom in our conception; would such a being be justified in concluding that the "infinitely great" was not infinite, but limited to the greatest of those atoms which were within his ken? If so, what would become of distant Sirius, or even of our own globe?

In reference to the seeming inconsistency in the review from which your correspondent quotes, he should bear in mind that it deals with matters "chemical," and not "mathematical;" the term "ultimate atom," or even "ultimate molecule," is perfectly legitimate, inasmuch as it implies simply the smallest particles over which the force of chemical affinity exerts an influence; that there should be nothing smaller than an "elementary atom" is inconceivable, for "half that atom" at once suggests itself, and so on *ad infinitum*. Again: he is scarcely explicit, or there is some incongruity in the phrase following that which I have quoted: "Infinite size we cannot deny." If "Hallyards" can conceive limitations (as he intimates), why not deny the infinities?

That "a thing is no larger than it is small," appears to be the obvious truism which "Hallyards" has stumbled upon in the concluding paragraph of his letter, but, unless I am mistaken, the words "large" and "small" are relative to one another, and not to any external conception of "ultimate greatness," or "littleness". To draw an analogy, is it an error to speak of the intensity of a certain light being greater than that of another, because the intensity of light stretches away into the infinite. ALEX. MACKIE.

[1663]—"Hallyard's" letter, 1653, on Ultra-Gas, cannot deny infinite size, neither can I deny infinite smallness; both terms seem to me equally contradictory, yet logic tells me that, if matter can be infinitely enlarged, or atoms infinitely multiplied, matter must, in its ultimate, be infinitely small or capable of infinite division. This is exactly what mathematics tell us. Large and small in mathematics, like hot and cold in physics, are relative terms, at the best arbitrary. Mathematics cannot deal with the infinitely large or small values. We cannot multiply figures infinitely, neither can we divide them infinitely. The capacity of our brain is finite, therefore "thought" arising from it must also be finite, and the most capable brains must arrive at a point where thought is impossible.

It may offend our vanity to find that the ultimate atom cannot be demonstrated, yet cannot be nothing; so that the infinite largeness of matter and the universe is beyond our comprehension, and yet it must be; but that only proves that our pride is greater than our knowledge, and that there are things which do exist, yet which we cannot know nor understand, because our thoughts are finite. F. W. H.

ARE TRIPE AND ONIONS OBJECTIVE OR SUBJECTIVE?

[1664]—In your impression of March 27, "C. N." writes (1647): "To *us* there is no external world, because all that we know is felt or thought, and is, therefore, internal." It may be so, but I have always believed that my Friday night's supper of tripe and onions had a most decided external existence before I had consumed it, and, although a small one, it was a world in itself. This may be vulgar, but it isn't bosh. Feeling and thought may be internal; but the things felt and thought, are they internal also? If not, then they are external, and, although only realisable to us through the medium of the senses, not the less external on that account.

The introduction of a few grains of that common sense which grows from common experience into what is called philosophical—in my opinion in no sense philosophical—speculation, would help materially to dispel much of that deceptive halo of utter nonsense that now envelops it. Then it might become a king's highway on which ordinary men might travel and gather knowledge. Now, it is, and for ages has been, as Longfellow somewhere expresses it, at first view a broad and well-laid road, but which as you proceed gradually narrows into a bridle-path, and then into a squirrel-track, and at last runs up into a tree. J. S.

[Do you not see that you are committing (from the metaphysical point of view) an absolutely unpardonable sin in appealing to common sense at all? It always strikes me that Berkeley's argument might be paraphrased thus. On the hand with which I am writing I wear a signet ring, with my crest on it. Now, no impression of that crest can be taken without sealing-wax. Hence, if all the sealing-wax (or other plastic material in the universe) were to be annihilated, *ipso facto*, my ring would cease to exist. You will, of course, understand that I only mention this heresy of mine in strict confidence.—ED.]

THE INTELLECT IN INSTINCT AND IN REASON.

[1665]—It would seem that in the consideration of instinct and reason the precise function of the intellect in these two processes has not been clearly perceived. Yet there appears to be little difficulty in proving that this element is of extreme importance, and that it furnishes light whereby sundry difficulties may be cleared up. All bodily action not purely spontaneous proceeds, as we all know, from some form of feeling or emotions, but in the actual performance or carrying out of this action as a means towards an end, or of a train of such actions, the intellect comes into play and operates as a guide or pilot. The steam-power impels the ship, but the man at the helm directs its course. In instinct this intellectual guidance is a force which (save the mere sensation) is wholly mechanical and unconscious: in reason the force is conscious and deliberate. In the former the action may be intelligent in practical effect, *i.e.*, means are adapted to ends as the seeming result of imagination and generalisation. In reality, however, the intellectual power at work is only unconsciously practical, is adaptive or ingenious in appearance only; it is merely a sort of organic association of ideas formed by persistent training in the individual, or in the species. In this process of learning the intellectual association of ideas assists at first, but, after a time, it gradually gives way, and drops out of consciousness. Indeed, sensori-motor actions frequently become wholly excito-motor. It has been maintained that some of the lower animals possess "a power of gathering up the past experience into rules of conduct that guide them in their solitary or gregarious life," and that "in the working out of a design they often learn to use special means when special ends have to be provided for." These processes, it may be assumed, are merely organic and mechanical, and are not the product of any practical talent guided by a general notion. This profiting by experience, moreover, is very limited, it relates merely to their food and mode of life. The imaging power and the recollection of the brute are too feeble and confined to influence to any comprehensive extent the actions and conduct.

When conscious intellect operates as the pilot of bodily action, it does so under two forms—1, association of concrete notions; 2, as a general or abstract notion. The former of these is illustrated by such feats as walking, riding, writing, balancing on the tight-rope, playing on a musical instrument, &c., also by many of the astonishing circus feats performed by horses, dogs, elephants, &c. A long and painful education is required in the mastery of accomplishments of this kind. At first, the mental association between the sensation and the requisite motion is difficult to form, but by and by, with practice and patience, it becomes more easy, and the feat is finally accomplished so organically, as it were, that at a subsequent stage it becomes almost wholly unconscious and reflex. It must be particularly observed, however, that no amount of general idea will assist in the performance of the feat. A man may have a clear and excellent general idea of what good caligraphy is, but he may be slower in learning to write fairly well than the smart and dexterous mechanical individual who has suppler fingers and more impressionable nerve-centres. These association-guided actions are all of a particular kind; they are strictly personal (so to speak); they are mere bodily movements whose end is near and immediate, not remote or external to and independent of the animal itself. After a time

they become engraved, as it were, in the mechanism of the nervous system, and are rendered capable of hereditary transmission to offspring, who exhibit them as original, innate, automatic, or instinctive capacities of action or habit. Young pointers, for instance, on being taken out into the field for the first time, have been observed to point, without previous training or experience. A series of individuals in the same caste or otherwise, labouring for years or for generations at any particular industrial art, gradually improve thereat, and acquire a marvellous dexterity and adroitness. And it must be carefully borne in mind that it is actions that are thus guided by the association of ideas or by physiological association, that, by the influence of special talent and of habit in the individual or in successive generations, are alone capable of becoming stereotyped, as it were, into permanent instincts. Actions directed by definite general notions possess no such hereditary or transmissible property.

The guidance of actions by (2) the general or abstract notion is possible to man, and to man alone, and it constitutes what is called "reason." By this important characteristic he can execute works in materials altogether external to his own body, and under novel, infinitely varied, and totally dissimilar circumstances of time, place, subject, &c.; he can, as it were, imprint on matter unequivocal evidences of design. His mind, illumined and constantly impressed by the general idea, can wield power over all Nature. The wondrous mechanical contrivances in the industrial arts, the arts founded on science, and the theoretic knowledge generated by art, are all brought within the compass of human attainment. These conscious, definite, and persistent general or abstract ideas of the end to be attained guide and light the way for the means towards its accomplishment. They enable the human judgment to decide beforehand what particular means are requisite, or are the most efficient enginery, for the accomplishment of those ends. These various plans and methods are invented by the imagination, whose operation is, however, rendered possible only by the power of abstraction and generalisation, assisted by that of voluntary reminiscence, whereby the idea, once generated, is kept before the mind, so as to be duly reflected upon and considered on all sides. A man, for instance, may go to consult an unknown doctor, being guided to him by the general notion of a "good doctor;" or a boat-builder modelling and constructing a new boat is actuated by all his previous intellectual knowledge, *i.e.*, his general notions anent the proper lines, breadth of beam, &c. These notions determine his work, because their relations to the means he adopts are incessantly before his mind. It is, we believe, the presence, predominance, and superintendence of these intellectual images or generalised notions that occasion actions guided thereby to be utterly independent of exterior circumstances. The ideal generally and non-cognisance of particular objects involved in the general notion are transferred or transfused into the actions which it dictates. Hence actions of this kind are only possible to human beings; hence they never become organic or deteriorate into instinct; they do not descend hereditarily to the offspring, and they are entirely beyond the sway and compass of natural selection.

Some profound cogitators opine that it is impossible to draw a line of exclusive distinction between reason and instinct. This opinion is probably correct if the acts only of these faculties be regarded, and not the nature and functions thereof. But if, as we have essayed to show, bodily action is influenced by the intellect in a twofold manner, we shall perhaps find in that distinction a ground of difference sufficiently precise and perspicuous. To endeavour to explain instinct by physiological action, by natural selection, by lapsed intelligence, and so forth, is scarcely sufficient. We must also strive to explain this wondrous, unconscious adaptation of means to ends by an innate faculty, original or derived, commonly termed instinct.

P. Q. Kegan, LL.D.

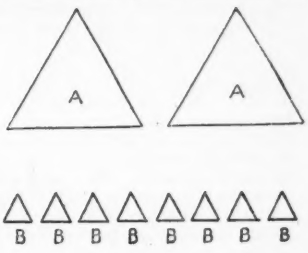
HOGARTH'S LINE OF BEAUTY.

[1666]—George Eliot's Tom Tulliver "could throw a stone right into the centre of a given ripple, . . . and could draw almost perfect squares on his slate without measurement. But . . . he was in a state bordering on idiocy with regard to the demonstration that two given triangles must be equal, though he could discern with great promptitude and certainty the fact that they were equal." (See "The Mill on the Floss," book II., chap. i.)

Suppose that Euclid's Book I., Prop. 4, has been here implied. The method of demonstration seems to mean such coalescence of the two triangles, A A, that their enumeration as "two" is no longer valid. Yet the drawing is by no means a dissolving view, and so the duality to the outer eye is unimpaired. Let the number of triangles be increased to a dozen, B B, &c., and here the civilised man over the savage, the schoolmaster over Tom Tulliver, may feel distinct superiority in faculty of enumeration. Again, lengthen the line and diminish the size till the triangles are dots, and innumerable, C C; then Tom Tulliver's intellect, set at liberty from comparing two triangles, may exert itself in comparing two parts of the one straight line, and discerning that they are both alike straight.

But which two parts? Take a ruler a foot long, and it will accurately gauge the straightness of some part of a straight line whose whole may be either a yard long or a furlong or a mile. The sensation by sight or touch of an inch of straight line, a foot, or a yard, repeats a cuckoo cry. Inch to inch, or inch to foot, foot to foot, or foot to yard, have analogy to each other. The multiplication of analogies produces vividness of conception, as a multiplication of musical strings sounding in unison produces a forcible tone. The straight line has tyrannical predominance over other forms. The action to which mental curiosity urges the eyeball, instead of being the smoothly rolling motion of looking at a landscape, becomes turned to the rapid pistonstroke-like action of ranging backwards and forwards, or up and down. The physical distress of this is illustrated when the student of books early resorts to the use of spectacles. Regarding the corresponding mental distress, the pedestrian may compare the feelings on plodding along a few miles of modern road, and on rambling along an old winding lane.

The principle is again illustrated when a boy—Tom Tulliver, or some other—instead of pursuing a perfectly safe footpath, deviates to the top of the steep bank which borders it, and makes his way



along that precarious footing. The distressing generalisation of a long length, is now opposed to the particularisation of every slippery footstep;—which is pleasanter?

Hogarth's beau-ideal of a line of beauty is "represented by a fine wire properly twisted round the elegant and varied figure of a cone."* If we take two very small lengths, *b c*, *d e*, of the spiral line Y Z, we find them so approximately similar as to coalesce into unity. But so soon as they become aggregated into a longer length, *b c d e*, the discernment of the difference in curvature between this and some other aggregation, *e f g*, comes into play; and so we are provided with the pleasure of an incipient generalisation, without the distress of its speedy completion into barren, stagnant totality.

An Old Draughtsman.

WILLIAMSON AND TARLETON'S "DYNAMICS."

[1667]—Amongst the "Letters Received" in your number of the week before last, "W. G. W." finds fault with the equations $f = \frac{W - T}{W} \cdot g$ and $f = \frac{W - W'}{W + W'} \cdot g$, and asks what is the meaning of Wg and $W'g$.

Both equations are perfectly correct.

I presume "W. G. W." will not dispute the truth of the funda-

* Hogarth's "Analysis of Beauty," Chap. VII., "Of Lines."

mental equation $P = Mf$, which becomes $W = Mg$ in the case of a body whose weight is W and mass is M, falling freely by gravity.

From these equations we get $f = \frac{P}{M}$ (1) and $g = \frac{W}{M}$ (2).

Equation (1) expressed in words means acceleration generated

$(f) = \frac{\text{Pressure producing motion}}{\text{Mass moved.}}$

Now, let two weights W and W′ be connected, as in Atwood's machine, by a string hanging over a fixed pulley; let M and M′ be their masses; T the tension of the string.

First consider the weight W, and suppose it to begin to move downwards. The pressure producing motion is the excess of W over T, or $W - T$; the mass moved is M. Apply equation (1); we get $(f) = \frac{W-T}{M} = \frac{W-T}{W} g$, by substituting the value of M from equation (2).

Next consider the two weights W and W′. Then the pressure producing motion is $W - W'$. The mass moved is $M + M'$. Applying equation (1), we get $f = \frac{W-W'}{M+M'} = \frac{W-W'}{W+W'} \cdot g$ by substituting for $M + M'$ from equation (2). As to $W g$ and $W' g$, there are no such expressions in the equations before us. $\frac{W-W'}{W+W'}$ is a factor which gives the ratio f to g. Whence g is determined—the great object of Atwood's machine. J. M. B.

LETTERS RECEIVED AND SHORT ANSWERS.

Senex. Undoubtedly, what you have observed has been the Zodiacal light; but I never remember to have seen its outline so ill-defined as it has been during its recent apparition. It is getting full late now, though, to see it at all. Unless my memory is at fault, I have myself had a profile view of a central mountain in Pythagoras much as you draw it. I cannot recollect the little crater in its summit, though. With regard to your second letter, the writer on whom you comment is not in this country at all. Scientific men are nearly all agreed that no evidence exists of spontaneous generation, or of the production of life from anything but pre-existing life *now*; but that is a very different thing from the definite predication that it never had, so to speak, an inorganic origin in the days when our world was solidifying from the primal fiery mist. With reference to the age of the planets, you are confusing their relative and actual ages. A dog at sixteen is very old indeed. When you were that age you were a boy. Assuming that all the members of the solar system pass through the same sequence of changes, the moon would be (viewed in the light of having accomplished them) of quite hoary antiquity as compared with Jupiter, which is still apparently red-hot, albeit Jupiter may have actually come into existence millions of years before our satellite. Read the article "Nebular Hypothesis," in "Nichol's Cyclopædia of the Physical Sciences."—A Puzzled Student. Get a piece of string 8 ft. long, and describe a circle by its aid of that radius. Call such a circle the earth's orbit. Now measure off two inches on the circumference of your circle; this will approximately represent the motion of the earth round the sun in a fortnight. At each end of your arc, and at as many intermediate points as you can get them in, describe circles, with a radius of ½ in., having their centres upon it. These will picture the moon's orbit. Put dots on these circles in proper progression, so that the moon they stand for shall go half round the earth while the latter moves through 14° (your two inches) of her orbit. If you will join all these dots by a continuous line you will soon see that the moon's path must be concave as referred to the sun only. "The general form of the orbit" as referred to the earth is highly complicated.—Georgium Sidus. "Twenty-seven" was carelessly copied from 27. The quantity given on p. 80 is probably more correct; but nothing really is known definitely on the subject.—A Salvation Army Sergeant. Your letter is of too purely a theological character for admission.—J. C. M. Ducroz. I have entirely lost sight of "Polyglot." In reading Darwin, begin with his "Origin of Species by means of Natural Selection," then go on to the "Variation of Animals and Plants under Domestication," and from that to his "Descent of Man." After this you may take the rest of his books in any order.—C. F. N. alleges that the hog, having but a thin covering of hair, "has developed a layer of thick fat between the skin and the flesh"; hence arguing that clothes are necessary to mankind in temperate climates. For myself, I always fancied that the fat on the hog was a purely artificial product, and that milk in the pig's wash, together with "sharps," pollard, peas, and the like, had not a little to do with it. Moreover, I seem to remember that in the hottest parts of China the pigs are at least as fat as ours.—A Christian. I am absolutely in accord with you, but the subject is one of those excluded by our rules.—Rev. Henry Briggs invites attention to the "Everycycle" as "the most comfortable and easy machine" he has "ever tried." Perhaps this may catch the eye of Mr. Browning.—The Shade of Parallax writes to the conductor of this journal from "Erewhon" anxiously anticipating the advent of his (the conductor's) incorporeal essence. If Mr. Proctor can by any means discover the whereabouts in space of the "Animula, vagula, blandula" of the departed earth-flattener, though, he will, as far as in him lies, himself make arrangements for going elsewhere!—Thomas Ayers. You should communicate your views to Professor Langley himself.—A. K. See "The Childhood of Religions" by our own esteemed contributor, Mr. Clodd. Also the paragraph in capital letters which concludes those heading the correspondence columns.—T. S. B. An excellent joke, but the delusion is too serious a one for its main issue to be obscured by a jest, however clever.—E. C. H. I am sorry to differ with any one whose ideas are so deserving of respect as those of the American *savant* whom you quote; but to pretend that (at all events) the darker parts of the moon's surface must not be highly heated by fourteen days' perpetual, and more or less vertical, sunshine, seems to me to contradict all terrestrial experience. Your second quotation simply refers to the relative amount of heat we receive from the sun. Taking it, for practical purposes, that all the solar heat passes through our atmosphere, on striking the earth it becomes partly converted into *dark* heat, to which the air is largely athermanous. At night such of this heat as can penetrate our vaporous surrounding is radiated into space. In summer, when the days are longer than the nights, the terrestrial temperature does continue to increase. In winter more heat is radiated than is received.—F. W. Rudler. Thanks, but the Vision-testing papers would have been of more immediate interest here.

Owing to the patriotic way in which printers have been serving their country in the Weald of Sussex, on Brighton Downs, and elsewhere—in fact, to Easter-holidayism generally—a quantity of correspondence is unavoidably held over until next week.

As it happened, I did not see any proof of the conclusion of this "Letters Received" column, on p. 292, last week. Hence, it comes to pass that my reply to Two Inquirers into Knowledge is scarcely reproduced as I wrote it. The initial part of that reply should read thus: "Premising that the change in the eccentricity of the earth's orbit is very slow (·000041 in 100 years); cannot continue beyond 24,000 years, when it must attain its minimum of ·0033; is, in fact, caused by the attractive influence of the other planets, and is confined within very narrow limits, I may proceed," &c. By the insertion of a non-existent "we" and a redundant "and" the compositor has rendered me less intelligible than I should prefer to be.

We have received a copy of the catalogue and descriptive price-list of electrical appliances manufactured by Messrs. Weedon & Irish, of the Electric Works, Sunderland. It is replete with information upon all that pertains to electric lighting and other of the applications of electricity.

Society for the Promotion of the Study of General History.—The second of a course of lectures by Dr. Zerffi was delivered at the Royal School of Mines, Jermyn-street, on Saturday, March 28, the subject being China. The lecturer explained that this nation had to be taken into consideration first, not because the Chinese was the oldest of civilisations, but because it possessed the oldest written records. The most striking feature in the life of this nation was its stationary character, it having remained in almost the same social condition for thousands of years. Dr. Zerffi then proceeded to discuss the causes of this strange phenomenon. The character of the land in which the people lived had no doubt had some influence; a complete wall of well-nigh impassable mountains isolated them from other races and other civilisation; the vastness of the plains and the immense length of the rivers could not but have produced an effect on their ways of thinking. The chief cause, however, was to be found in their stereotyped social organisation, formed and worked on the patriarchal notion of government—being, in fact, but the family on a gigantic scale. He then gave a brief sketch of the first five kings, and explained that the only historical significance which this mythic account could have was that the five kings were but the representation in traditional record of five periods in the past life of the nation. He also drew attention to the important part which the number 5 had taken in early Chinese thought. This was followed by a rapid glance at the historical dynasties up to the invasion of Kubla Khan, and the introduction of Buddhism as the State religion in the eleventh century A.D. Dr. Zerffi then passed in review the Chinese system of centralisation, which, though originally founded on high moral principles, had checked development and cut off all possibility of real progress. The next lecture will be on the "Sacred Books of the Chinese."

Our Inventors' Column.

We give here, week by week, a terse description of such of the many inventions as we think may be of use to our readers. Where it is possible, the number of the patent is quoted, to enable those who desire fuller information to procure the specification from the Patent Office in Cursitor-street, Chancery-lane. We shall, generally speaking, confine ourselves to the more recent inventions; but it often happens that an article comes under our notice which, although not quite novel, is worthy of mention for its utility and ingenuity. In such a case we should not hesitate to refer our readers to it. And while we thus increase the interest of our pages, we at the same time assist the inventors by giving greater publicity to their inventions (KNOWLEDGE *being a popular magazine*) *than is accorded by the most excellent trade journals.*

ADJUSTABLE INSTANTANEOUS SHUTTER.

[Patent No. 7746. 1884.]—The principle of this shutter, patented by Mr. Thomas Furnell, consists in the use of two flaps so adjusted

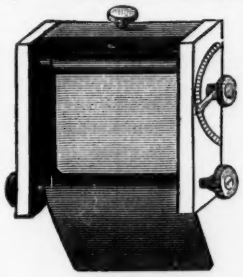


Fig. 1.

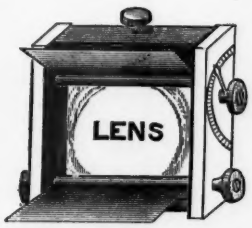


Fig. 2.

to each other, by mechanical means, that the amount of exposure that can be given to the foreground, in proportion to the sky, can be governed at will; as the bottom flap can be set and clamped in any desired position, the top flap remaining closed ready for exposure. The bottom flap has a sweep of about two hundred degrees; the top flap only about ninety-five degrees, and remains as a sky shade. Fig. 1 shows the shutter set ready for action; Fig. 2, arrested at full open; Fig. 3, folded for portability. The ratio of movements of the two flaps are so arranged, that the first slow movement of the bottom flap causes a first rapid movement of the top flap, which slows as it rises. This gives a greater proportion of exposure to foreground, and less to the sky; and to counterbalance this, the bottom flap commences slow and increases in speed as it rises, and so cuts off the exposure of sky portion. The following are the different positions taken by the flaps:—

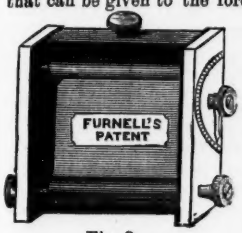


Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

If the bottom flap be set, as shown in Fig. 4 or instantaneous work, the foreground receives the greatest amount of exposure, although the motion is extremely rapid. If the bottom flap be set as at Fig. 5, both flaps rise together until full open, then the top one remains as a sky shade, and the bottom one flies up and closes. If the bottom flap be set as at Fig. 6, it is the most suitable for seascapes, as the top flap arrives at the horizon line at the same time as the bottom flap arrives at full open. This flap then flies up and closes, so that the sky portion receives but a very small amount of exposure in proportion. Fig. 7 shows the position of the flaps at the end of exposures. Arrangements are made for prolonging the time of exposure at full open, or for focussing when required. The flaps are formed of ferrotype plate, and made to act as springs, to resist jar, or shake. This plan proves very effective, as the movements cannot be felt if held in the hand during action. This is one of the points claimed in the patent. The apparatus is very ingeniously designed, and, with due care, there is no reason to anticipate its failure. It is claimed to be unequalled by any other shutter extant for giving cloud-effects, with equal density of negative throughout of foreground and sky.

DRAIN INSPECTION PIPE.

Mr. G. C. Davies, of 65, Lausanne-road, S.E., has patented a "Cast-iron Inspection or Access Pipe for House-drains," which has every prospect of being very extensively adopted.

There are several devices in stone or earthenware that have been used for the purpose of inspection or access to house-drains, and which may be all very well for rain or surface water, but from one cause or other they are defective for the purpose of soil-drains. It is asserted that an inspection-pipe to be depended on for soil-drains could not well be made in any earthenware material; for if the cover over the aperture is bedded down and made gas-tight at the time (an operation that requires some care to ensure it being so) the joint is always liable to be broken and the cover lifted by heavy flushing, or by the drain getting stopped up, besides being always liable to breakage by the workmen.

These inspection pipes invented by Mr. Davies are made of strong iron castings, 2 ft. 6 in. long, and can be made to suit any size pipes, either iron or stoneware. They are especially intended for the use of soil or foul-water drains, in order to keep the foul-gas area of same to the minimum, and to avoid the expense and nuisance of breaking open the drain, should it at any time get choked or stopped up.

The pipes are provided with a longitudinal aperture, which is ordinarily covered in, but which, when necessary, may be removed for inspection purposes. Fig. 1 is a plan showing the under side of the cover over the inspection aperture, A being the curved soffit forming a section of the inside periphery of the pipe. B B shows the position of the gun-metal screws, for securing the cover to the pipe. D is the groove for receiving

Fig. 1.

Fig. 2.

the stuffing material for making the gas-tight joint. Fig. 2 is a plan of the pipe with the cover off, showing the aperture for access, &c., E being the tongue running round the aperture corresponding to the groove D in the cover.

Fig. 3 is a transverse section (enlarged scale) through the centre of pipe, A, showing the inside of the cover when fixed in position on the pipe. B, the gun-metal screws. C, the eyes at each end, when necessary, for lifting the cover. D, the groove-and-tongue gas-tight joint, running round the inspection aperture. The gas-tight joint is made by filling the groove D in the cover level all round with the stuffing material; clearing off all dirt and surplus cement from the parts forming the joint; placing the cover in position, pressing close, and screwing down. The cement or stuffing may be white lead, with just sufficient tallow when necessary to keep it from hardening. It will be noticed that no skilled labour is requisite to make this joint. The advantages secured by using these pipes are:—1. Simplicity in making

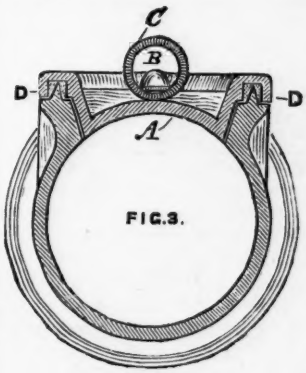


FIG. 3.

Fig. 3.

the gas-tight joint. 2. They obviate the inconvenience and danger arising from manholes with open channels. 3. The effectual flushing of the drain is secured, as the inside form or bore of the pipe is maintained throughout. 4. The seal of the cover cannot be broken by heavy flushing, or by the drain getting stopped up. 5. The form of the inspection aperture admits of the drain being readily examined, and the cleansing rods being worked with ease throughout. 6. The benching-up of the sides of the manhole chamber, and the expense of an air-tight door, together with the ventilating pipe, are dispensed with.

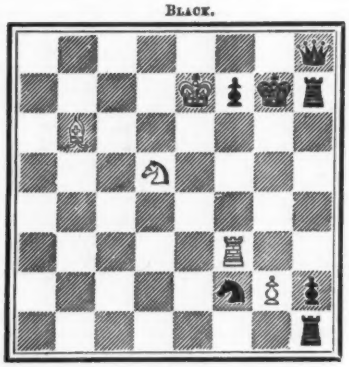
Our Chess Column.

By MEPHISTO.

END GAME.

BY B. HORWITZ.

BLACK.



WHITE.

White to play and win.

Position of a game played at the odds of Pawn and move in the Handicap Tournament at the City Club:—

J. GUNSBERG.

BLACK.

WHITE.

B. VYSE.

Black played	P to QR3
P to B4	
A sacrifice justified by the position.	
	P × Kt
RP × P	Q to Kt5
Q to K sq.	

Better than playing Q to R4; the Black K can only play to Q2 at considerable inconvenience, as by P to KR3 White threatens to take possession of K6 with his Q, when he should obtain a very strong game.

	P to R5
P to R3	

White pursues his attack with determination. In spite of the result of this game, we believe that White, even after giving up his second Knight, might have won.

	Q × Kt
Q to K6 (ch)	K to Kt sq.
R to B3	

This looked the best. Of course there is no reply to KR to R3; but we think that the less showy move of B to K3 would have won. The position is full of combinative possibilities.

	Kt (K2) × P

Black owes his escape to this move.

R × Q	P × R

This is important, for if now P × Kt, Black threatens R to K sq.

Q to K sq.	Kt to Kt3
B to K3	R to K sq.
Q × P	KKt to K2
B × Kt	Kt × B

and Black ultimately won.

SELECTED PROBLEM.

BY E. PRADIGNAT.

(Special prize in *Baltimore Sunday News.*)

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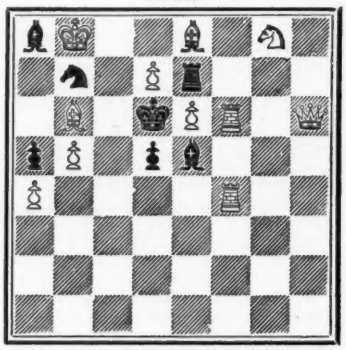

WHITE.

White to play and mate in three moves.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Correct solutions received of W., Ravenshoe, Uncle John.

BILBAO.—In Problem 150, 1. Q to B7, B to B5. 2. Q × B, K to K3, and their is no mate.

Note.—White's thirteenth move in game, p. 294, should be Q to Kt4 (ch.).

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